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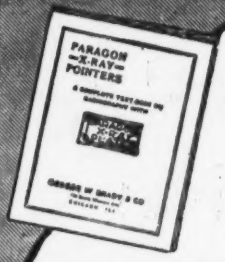

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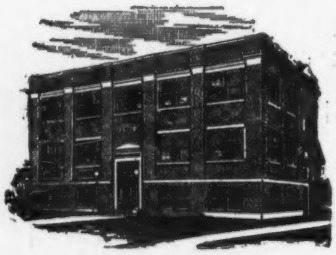

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OBSERVATIONS ON THE PATHOLOGY OF FOREIGN BODIES IN THE AIR AND FOOD PASSAGES

BASED ON THE ANALYSIS OF 628 CASES[1]

BY CHEVALIER JACKSON, M.D., F.A.C.S., PHILADELPHIA

THIS paper will not deal systematically with all phases of the subject, because to do so would be to repeat much matter that has previously been written by the author and collected in textbook form (1). It would seem more profitable use of time and space to deal with new phases or new observations on the previously considered phases of the subject. To report many cases *in extenso* would unduly lengthen this paper; therefore, with a few important exceptions, comments on cases will be inserted here and there, as may seem apropos, and a table of cases will be appended.

Autoptical opportunities have been limited to a single case; therefore, most of the observations herein concern the living pathology, endoscopically observed.

The author regards himself as very fortunate in having had a sufficiently large experience to afford many opportunities to contrast the endoscopic appearances of recently aspirated foreign bodies with cases of prolonged sojourn of other foreign bodies of the same or similar physical character. Thus we are able to record and contrast the immediate and the later pathological changes produced by short and by prolonged presence of a foreign body in the air passages. Unfortunately, a similar opportunity has been afforded to only a slight extent in regard to foreign bodies in the œsophagus; for, while recent œsophageally-lodged foreign bodies are very numerous, cases of prolonged sojourn are much less common in the gullet than in the air passages.

Results of bronchoscopy and œsophagoscopy. Though treatment is not within the scope of the present paper, it may be germane merely to mention the fact that with the development of roentgenography for diagnosis and of bronchoscopy and œsophagoscopy for removal, the future should see very few cases of prolonged sojourn of foreign bodies that have entered through natural passages. Statistics in the author's clinic remain about the same, namely 98.1 per cent of successes; the slight diminution being due to the fact that an increasing percentage of the easier cases is eliminated by the successes elsewhere, resulting in an increasing percentage of patients arriving with pathologic complications or with complicated mechanical problems. Our mortality has been less than one-half of 1 per cent directly attributable to the endoscopic procedure. Taking together all deaths from any cause whatever within one month after endoscopy, the mortality has been 1.9 per cent.

Ultimate results after removal of the foreign body in long-standing cases. From a pathologic viewpoint it is unfortunate that we have had no autoptical opportunities in any of the

[1] Muetter Lecture, 1917. Delivered before the College of Physicians, Philadelphia, December 14, 1917.

cases from which we have removed a foreign body of prolonged sojourn. Of the 23 cases in which the foreign body had been present for periods ranging from 2 months to 26 years, all of the cases recovered perfect health except two. One of the two died about a month after removal of a nail that had been in the lung for 4 years. Postmortem was unobtainable; but the symptoms pointed clearly to embolism of the middle meningeal artery. The child was known to have an endocardial lesion secondary to the septic pulmonary focus; but whether the embolus was from this or from the primary infective focus in the lung, obviously could not be determined (4). The other fatal case died of some thoracic or abdominal condition of sudden onset, the nature of which could not be determined. He had been playing about outdoors, apparently in good general health. No autopsy was obtainable (4).

The recovery of lung tissue from such extensive and prolonged suppurative processes as those present in some of the cases is very remarkable (see Roentgenograms, 17 and 18). The case of Mrs. K., from whose lung we removed a glass collar button that had been in the lung for 26 years, is one of the most interesting. She had emaciated from septic toxæmia until she weighed only 98 pounds. Two years after removal of the collar button she had regained perfect health and today weighs 182 pounds. The physical signs over the lungs show no abnormalities (5). All of the other cases made good recoveries, except the two cases noted above (21 recoveries, 2 deaths, out of 23 cases. No operative mortality).[1] In some of the cases it was necessary to dilate a cicatricial stricture to gain access to the foreign body for removal. It seems unlikely that from a single dilatation the lumen would remain dilated; but, of course, it must be remembered that the lumen of the stricture was occupied by the foreign body which was itself, by its bulk, a large factor in the obstruction; so that probably the better drainage was due as much, if not more, to the removal of the foreign body which occluded the strictured lumen. Granulations are also an impediment to drainage. While, doubtless, they do not disappear for some time, yet it is logical to suppose they would gradually recede after the removal of the cause of their presence. Their recession would constantly improve drainage. Repetition of the bronchoscopic dilatation of a bronchial stricture for the improvement of drainage is very easily carried out without anæsthesia; but, so far, our foreign-body cases have not seemed to require it.

[1] Seven recent cases are not included; because, though now recovering rapidly, time enough has not yet elapsed to class them as cured.

VARIOUS CLASSES OF FOREIGN BODIES

The list below includes the various classes of substances I have removed from the air and food passages. Needless to say it has been impossible to distinguish a different kind or degree of inflammatory reaction peculiar to each class. On the other hand, I have been able to distinguish a marked characteristic and unmistakable difference between certain classes.

The following is a classified, not an itemed list. In the absence of complete chemical analyses of the particular specimens, the exact composition of some of the alloys is somewhat uncertain. The combinations are those in common use in the arts and trades.

Metals

Iron, wrought.
Iron, cast.
Iron, malleable.
Steel, low.
Steel, low, galvanized.
Steel, low, nickel-plated.
Steel, low, copper-plated.
Steel, tool, tempered.
Steel, tool, untempered.
Brass (an alloy of copper and zinc, sometimes tin also).
Brass, high.
Brass, low.
Brass, cast.
Brass, lacquered.
Brass, nickel-plated.
Brass, gold-plated.
"Brass" plating.
Copper, pure (practically).
Copper, alloyed with tin (bronze).
Copper, alloyed with lead (pewter).
Copper plating on steel.
Gold, solid, pure (practically).
Gold, filled.
Gold plating.

Silver, pure (practically).
Silver, alloyed.
Silver plating.
Tin plating.
Tin, alloyed with lead.
Tin, alloyed with silver and mercury.
Tin, alloyed with copper (bronze).
Lead, pure (practically).
Lead, alloyed with copper.
Lead, alloyed with tin.
Lead, alloyed with antimony (?).
Lead, alloyed with bismuth (?).
(These alloys are the usual ones in pewter of which we have had many instances as foreign bodies).
Zinc (galvanized coating on iron and steel).
Zinc, alloyed with copper (brass).
Zinc, probably present in other alloys.
Nickel, alloyed with copper.
Nickel plating on iron, steel and brass.
Aluminum, pure (practically).
Mercury, as an amalgam with tin and silver.
Antimony, alloyed with lead.
Bismuth, alloyed with lead.

Minerals (other than metals)

Glass.	Anthracite coal.
Enameled ware.	Pebbles.
Porcelain.	Diamonds.

Animal substances

Bones, mammals.	Wool fiber.
Bones, mammals, processed.	Hair (bristles).
	Horn (buttons).
Bones, birds.	Pearl shell.
Bones, fish.	Shellac.
Meat, mammals.	Seed lac.
Meat, birds.	Entozoa.
Meat, fish.	Blood clots.
Teeth, human.	Cheesy débris.
Cartilage, human.	Ivory.

Vegetable substances

Nut kernels.	Celluloid, jewelry, poker chip.
Nut shells.	
Seeds.	Paper.
Hulls.	Vegetable "ivory."
Burrs.	Wood.
Grasses.	Rubber, soft.
Fruit pits.	Rubber, hard.
Fruit pulp.	Lacquer.
Cotton fiber.	

"CORROSION" AND OTHER CHANGES IN THE FOREIGN BODY ITSELF

From a viewpoint of biologic chemistry this question is of only academic interest. But, clinically, it bears importantly on the question of reaction of the tissues to the presence of the foreign body, not only by the changes in the physical qualities of the surface, rendering smooth surfaces rough and mechanically irritating when moved about by pulsatory, respiratory, and bechic forces; but, conceivably, in the chemicals given off in the dissolving or in the corrosive processes, the penetration and incubation of the bacteria, etc.

Wrought iron and steel foreign bodies appear in our case-records as having been present in the lung for periods varying from 2 hours to 11 years. In one case time was unknown, probably since boyhood of a man, aged 23 years. From examination of the specimens it seems certain that corrosion takes place rapidly at first and more and more slowly as the crust of corroded metal accumulates. The metal in three cases (400, 410 and 569) became a mere mass of corroded material resembling coke. It lost its tensile strength and crumbled when pulled upon by forceps. The tissues had built around it in both these cases a cicatricial encasement with a narrow strictured neck from which pus escaped, but through which there seemed no possibility of the corroded material being extruded either in crumbs or *en masse*. In a number of cases, notably Case 408 the bulk of the foreign body was greatly increased by the heavy corrosive crust, thus interfering with drainage. The polish disappeared from blued steel pins in 2 days in some instances and corrosion was always manifest when the pin had been in 4 days or longer. Galvanized coating on steel staples, nails, etc., disappears totally in 1½ years, as shown in Case Fbdy. 409. The staple in this case was corroded quite deeply, a thick crust covering all parts of the staple. This crust was black when the staple was removed; but when dried had rather a reddish, rusty appearance. This reddish appearance was not noticeable on any of the other corroded steel or iron foreign bodies. The rapid disappearance of the galvanized coating from galvanized steel foreign bodies may be favored by galvanic action.

Cast-iron bodies we have not had in sufficient number justly to compare the degree of corrosion. Case Fbdy. 550 was one of cast iron in the bronchus for 3 days. In this short time good tool steel, such as is used in shawl pins and dental instruments would have

corroded sufficiently to be quite manifestly blackened. On the contrary, the cast iron in the case referred to did not give off any black stain on a clean white linen cloth. Cast-iron jacks in the œsophagus 2 weeks in one case (P. E. 234), and 2 months in another (Fbdy. 558), seemed to have undergone almost no corrosion.

Brass objects were present in the lungs of our patients for periods varying from a few hours to 10 years. Examination of these specimens shows that it corrodes much more slowly than wrought iron or steel. In Case P. E. 266 the thin brass wires, if of steel, judging by comparison with Cases 569 and 410, would have crumbled away when removed. The lacquer put upon brass to protect it from atmospheric corrosion seems to disappear very quickly from lacquered brass foreign bodies in the air passages. Nickel-plating on brass seems to disappear quickly, though doubtless the removal is the result of the attack of the secretions on the brass underneath, the start being obtained at spots where the plating is deficient. The mottled irregular shape and depth of the patches of corrosion on many foreign bodies, notably of the atomizer tip in Case Fbdy. 611, seem to support this view. The atomizer tip had been in the lung 1½ years. The precisely similar foreign body in Case P. E. 230, was not corroded at all in 10 days. It is possible that galvanic action may favor the removal or undermining of the plating on nickel-plated brass objects.[1]

Copper corrodes very quickly and deeply, the corroded surface quickly becoming rough and black. So-called copper coins are in some instances made of bronze. We have not yet made a chemical determination as to which coins were bronze.

Gold seems to be very slow to tarnish. Gold-plated brass seems to lose its plating very quickly, and then to corrode as rapidly as unplated brass. Doubtless, the attack is on the underlying metal, beginning at defective places in the plating.[2]

Nickel in the form of coins seems to be relatively slow to corrode. Nickel-plating on brass is quickly removed as mentioned under "brass." Nickel plating on steel has been noted in only 3 instances and it seemed to be yielding to attack in the same way. In the œsophagus a thin yellowish, adherent coating appears on a "nickel" coin in a central zone similar in position and area to that shown on silver coins (Figure 20, Plate II). The nature of this yellowish coating has not been determined; but as the so-called "nickel" coin is about 25 per cent copper the coating may be cupric.

Silver is very quickly corroded. The prompt formation of a heavy coating of black sulphides is more quickly developed, apparently, in the œsophagus than in the air passages; but after silver objects have remained for a considerable time in the air passages they begin to develop a heavy coating quite rapidly. Possibly this delayed activity is due to the sulphides liberated by bacterial activity. In the œsophagus a heavy black coating appears promptly in a central zone, while the lateral zones which are clasped by the tissues remain very bright. (Case Fbdy. 628. See Figure 20, Plate II.) It remains to be determined whether the sulphide of silver or a nascent agent is bactericidal.

Lead more or less alloyed was not infrequently encountered. It seems to undergo very slight corrosion. In one instance (Case P. E. 243) but slight corrosion had occurred in a 10 years' sojourn in the bronchi. The corrosion was slight also in Case Fbdy. 440, in which the lead alloy collar button had been present for 9½ years. In both these cases the pus had been exceedingly foul for years. If this foulness was due to sulphides it seems strange that the lead was so slightly acted upon. The nature of the hardening alloy has not yet been determined.

Zinc was encountered as a galvanized coating on various iron and steel substances. In these the zinc disappeared very quickly, possibly as the result of galvanic action or of the undermining of the coating by attack on the underlying metallic base. Zinc as an alloy was probably present in many of the metallic foreign bodies.

Tin was encountered as a coating on wire. It seemed not to have undergone any notice-

[1] A brass screw in the lung 4 months, removed after the delivery of the Muetter Lecture, was as bright as if newly made (Case Fbdy. 636).

[2] *Vide infra*, footnote relative to hard-rubber intubation tube.

able change in 6 weeks. The exposed parts of the steel wire were considerably corroded. The possibility of galvanic action is worthy of consideration. The amalgam fillings which doubtless contained a large proportion of tin, with silver and mercury, did not seem to be corroded but none was in the air passages more than 2 weeks.

Wood in the two instances encountered seemed to have undergone no change other than swelling in 10 days' and 3 days' time, respectively.

Rubber, hard and soft, seems to undergo little or no change. In Case Fbdy. 622 the rubber had been in the bronchus (or trachea) for a period of 7 months and seemed to be unchanged. The surface looked slightly more porous than a new eraser; but not so markedly that it could be said to have undergone any great degree of change. Vulcanite seems quite resistant; but the duration in our cases was not long.[1]

Pearl-shell did not lose its luster in the œsophagus in over 1 year; but it was incrusted with a calcareous-looking deposit in patches. It is possible that this incrustation was deposited during the lifetime of the mollusk from whose shell the foreign body had been roughly fashioned by a boy. Pearl buttons seemed to be unaffected but their sojourn was short.

Bones seem to change very slightly. If any disintegration goes on it is so little as to be unnoticeable. Of course, there is no means of knowing the exact weight or size of the foreign body before aspiration; but in Case Fbdy. 608, the bone had been *in situ* 10 years, and was as large as could have been aspirated through the glottis of a child of 10 years, which was the age of the patient at the time of aspiration. The color of the bone (beef) was dark purplish brown. In Case Fbdy. 385, the chicken bone was in the lower air passages for more than 1 year. It was cracked open, evidently before aspiration, and was slightly disintegrated superficially. Whether this disintegration was because of its being avian bone, its age, or because it was naturally cancellous with but a thin cortex, could not be determined. The differences of duration of sojourn prevented a just comparison as to disintegration between the bones of mammals, birds and fish, all of which are represented in our series of cases.

Meat (muscle, connective tissue, periosteum, etc.) was attached to bones in only two recent cases of bronchially-lodged bones. In these it was foul and soft. Doubtless, it was present in other cases, but had been quickly removed by the bacteria. It was, of course, cooked.

Horn and vegetable "ivory," of which buttons were made, were unaffected but none was in for a long period.

Glass, in our experience, was unaffected in surface except in three instances in which incrustations were deposited after long sojourn. In Case 244 P. E., in addition to the incrustations, the gloss usually present on glass collar buttons had apparently been dulled; but, of course, there was no way of knowing what sort of surface was present when the collar button was aspirated 26 years previously. The glass heads of pins seemed to be unaffected as to the surface. In two instances they were slightly incrusted.

Fiber or composition. which is a manufactured material resembling paper, but impregnated with shellac or other substance to render it impervious to moisture, was found in shoe buttons. One of these (Case Fbdy. 630) was present in the bronchus 7 months without apparent change except loss of polish. In another case (P. E. 351) the button was heavily coated with incrustations after 11 months' sojourn. Composition heads to "mourning" shawl pins were unchanged after a few days' sojourn.

Nut kernels are supposed to disintegrate in time, but we have found no evidence of it clinically. The longest duration was one month and even in this time a roasted peanut kernel seemed to be in about the same condition as one purchased for comparison. Some degree of swelling probably occurred.

Maize, *beans*, and other dried starchy vegetable substances seem to undergo no change other than swelling. This has an important pathologic bearing because of the pressure

[1] In a recent case an O'Dwyer intubation tube, composed of hard rubber vulcanized on a gold (alloy?) lining had remained in situ one year and four months. There was a diffuse tracheobronchitis with a bronchiectatic dilatation above the foreign body. The outside of the rubber was very much roughened with concretions. The gold seemed to be covered with a reddish brown crust.

exerted on the tissues, and, especially because of the increased interference with drainage.

Seeds, hulls, watermelon seeds, peach stones, cherry pits, etc., were found unchanged by sojourns of from 1 to 15 days.

Anthracite coal, chinaware, enameled ware, human teeth, wool and cotton fiber, seemed to have undergone no change; but the duration was in all of these cases relatively short.

REACTION OF THE TISSUES — INFLUENCE OF THE CHARACTER OF THE FOREIGN BODY ITSELF ON THE REACTION OF THE TISSUES TO ITS PRESENCE

The broadest classification is as follows:

1. *Shape and size.* A foreign body that does not obstruct drainage from, or aeration of, the conical mass of lung tributary to the invaded bronchus, in our observations, has produced less reaction than a foreign body of the same physical and chemical characters, but of such size and shape as to occlude the invaded bronchus in such a way as to obstruct drainage and aeration.

2. *Surface qualities.* A rough or sharp foreign body may traumatize the mucosa, but the reaction of such trauma seems to be limited to the immediate neighborhood of the trauma. If the intruder is knocked about by coughing, the trauma may be scattered in patches in different localities. So far as we are able to determine from bronchoscopic observations, once the foreign body becomes fixed these traumatized areas heal promptly provided drainage is unobstructed. In children, swelling of the subglottic tissues is apt to interfere with bechic expulsion, and then intense diffuse reaction is usual, regardless of the nature of the foreign body.

3. *Composition and character.* (a) The least reaction of the bronchial tissues to the presence of foreign bodies is caused by iron and steel, provided the intruder is of such shape and such size, relatively to the size of the particular bronchus invaded, as not to interfere with the drainage from, and aeration of, the subjacent lung area to which the invaded bronchus is tributary. Further experience may make an exception to the foregoing statement in case of pure gold and pure silver, of which our examples are fewer and of shorter duration than the iron, brass, and lead foreign bodies. Platinum, of which we have encountered no instance, may also be an exception. Cast iron seems rather more irritating than steel; but the number of cases is too small to be certain.

b. Next to iron and steel the class of substances least irritating, other things being equal, is metallic substances other than iron and steel.

c. Next in order comes the dense non-absorbent mineral substances, such as pebbles. Probably enameled ware and anthracite coal should be included here, possibly also chinaware, but as only one case of each has come to our clinic the data are not sufficient to warrant the statement. Glass seems least irritating of all, but as we have only one case of very long sojourn, I have not put it ahead of iron and steel. We have had 3 cases of short sojourn, and 17 other cases in which the foreign body was partly of glass, such as glass-headed shawl pins, imitation diamonds, etc.

d. Most organic substances set up more extensive and severe inflammatory reaction than mineral substances. The one marked exception to this is bone, which seems to create singularly little reaction, considering its combined septic and surface characters that favor trauma.

e. Maize, dried and uncooked, seems to set up a severe reaction, greater than any metal but not quite equal to that of peanut kernels.

f. The most irritating of all substances we have encountered in the air passages is roasted peanut kernels. Other nut kernels (raw) are also very irritating; whether less or more so, has not been determined because of the remarkably less frequency of occurrence of kernels other than peanut as foreign bodies. The botanical and chemical differences between true nuts and peanuts are well known; but the bearing on the reaction of the tissues to their presence has not heretofore been studied.

Having thus broadly referred to the subject of the relative degrees of reaction observed bronchoscopically in the various classes of foreign bodies encountered, we will now

consider some of the classes a little further. Additional observations have, for the convenience of the reader, been placed in the description of the colored plates.

Iron and steel. Our case records are very rich in observations of iron and steel foreign bodies present in the bronchi for periods varying from a few hours to 9½ years. In one case (Fbdy. 400) the intruder had probably been in the lung since childhood of a man, 24 years of age. From these observations it is clear that iron and steel bodies set up quite slowly a very slight and strictly localized reaction, provided they do not, by their shape, obstruct drainage and aeration. It is only when, after prolonged sojourn, the bulk of the foreign body plus swelling of the tissues, plus granulations, plus stricture, results in obstruction that abscess, bronchiectasis and extensive tissue changes take place. Even then the changes are limited to the conical mass of lung to which the invaded bronchus is tributary. The bronchi of the other side are so invariably free from inflammatory changes that it is possible always to decide, in any case of prolonged sojourn, which lung to explore, from a comparison of the endoscopic appearances on the two sides.

Interesting comparisons of iron and steel foreign bodies are shown in Figures 1, 2, 3, 4, 6, 7, 8, 9, 21, 22, 23, 24, 28, 29, 30 and 31, Plate I.

Brass is one of the most frequently encountered metals in bronchoscopy for foreign bodies. I have been able to compare the results of sojourns of various periods ranging from a few hours to 10 years. The inflammatory processes even in the cases of longest standing are strictly localized, being limited to the invaded bronchus and the area of lung tributary thereto. It seems clearly demonstrated that a brass foreign body of such size and shape as not to obstruct drainage or aeration will cause only slight and strictly localized congestion followed by localized moderate inflammation. When, however, the inflammatory products have reached the stage in which the bulk of the foreign body, plus the swelling, plus the granulations, plus the thick secretions interfere with drainage, the saprophytes break down the pus into irritating materials, and the defective drainage and aeration otherwise result in a more rapid tissue destruction; but even then the extent of destruction, considering the duration, and judging by the recovery of functionally good lung, is most remarkably slight. Interesting comparisons are shown in Figures 14, 19 and 26, Plate I. Comparison of long and short sojourns of nickel-plated brass are shown in Figures 12 and 13, Plate I.

Lead. Our experience with lead as a foreign body has been relatively large and we are able to compare the reactions set up by sojourns varying from a few days to 10 years in the bronchi. (See Figures 17, 18, 19, and 20, Plate I.) In addition to Figure 17, there have been many cases of short sojourn, mostly pewter, jewelry, and toys. From this experience we are able to state that the reaction from lead is relatively slight, slow to develop, and always localized if the intruder is not of such shape as not to interfere seriously with drainage and aeration. Doubtless there is more or less alloy in all my lead foreign bodies.

Gold seems to be quite unirritating to the tissues, but no case of very prolonged sojourn was observed in which solid gold of relative purity was concerned. Plated objects lost their gold coating very promptly. "Filled" and heavily alloyed gold objects seemed to exhibit about the same phenomena as brass. It may be that pure gold would be found to set up less reaction than steel if we could observe a case of a relatively pure gold foreign body present for a prolonged period. In Case P. E. 354 (Figure 27, Plate II) a gold locket in the œsophagus had set up no inflammation or even congestion. In Case Fbdy. 426, Figures 21 and 28, Plate II, a gold "filled" cuff-link had ulcerated through from the œsophagus into the trachea in 3 months' sojourn in an infant 6 months old.[1]

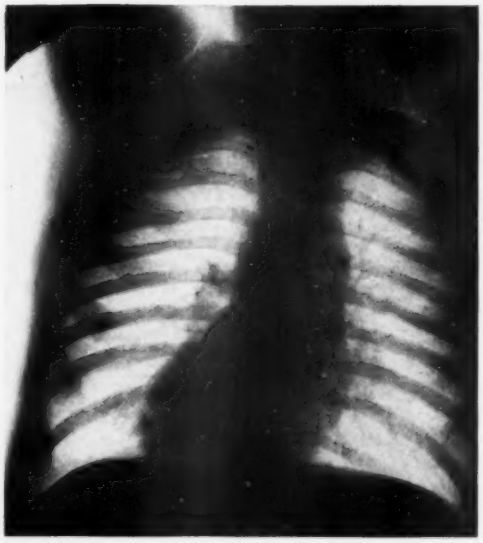
Silver in a recent case seemed to have caused practically no inflammation. In cases of longer standing the irritation seemed very slight. Whether or not the sulphide of silver, or some substance in a nascent state is bactericidal, remains to be determined. The corrosion in 5 days in the œsophagus is shown in Figure 20, Plate II.

[1] *Vide supra*, footnote relative to hard-rubber intubation tube.

Aluminum we did not encounter as a foreign body in the bronchi; but a long experience with aluminum intubation tubes in the treatment of laryngeal stenosis leads me to believe that so long as it retains a smooth surface it is relatively unirritating; but it has a strong tendency to become pitted and to become coated with incrustations. In one case that left the hospital without permission and returned after 4 months, the surface of the tube was, in patches, like sandpaper in color and roughness, owing to the incrustations. After removal, the metal was found deeply pitted. The tissues, which had been epithelialized cicatricial structures, were denuded of their epithelium and were covered with granulations where the incrustations had been embedded.

Plated, galvanized, and tinned objects of all kinds seem to lose their plating or coating in a remarkably short time. Whether this is due to galvanic action or to the undermining caused by the attack on the basic metal, a start being obtained at a defectively coated spot, has not been determined. In Case Fbdy. 409, the heavily galvanized steel staple was so deeply corroded into the steel in a 1½ year's sojourn that the protective galvanizing must have been off in a few months after its aspiration. Nickel plating had entirely disappeared and the underlying brass was deeply corroded in the atomizer tip present 1½ years in Case Fbdy. 611. Gold plating seemed to have lasted but a short time on various pieces of jewelry in numerous cases.

Pebbles and glass, if smooth and free from sharp edges as in Cases Fbdy. 624, P. E. 359 and P. E. 361, seem to produce but little reaction unless they "cork" a bronchus. In neither of the "corked" cases was the intruder allowed to remain long enough for extensive destruction to take place. In Case P. E. 244, the glass collar button was present 26 years. It is quite clear from the history that the collar button caused very little irritation for many years. Gradually, however, the secondary purulent processes developed, ending in lung abscess and pyopneumothorax, reducing the patient to a septic wreck weighing 98 pounds. What her original weight was is unknown but after the glass collar button was removed the patient gained in weight to 182 pounds. It seems probable that the collar button, which when found bronchoscopically was fixed in a position with the post crosswise, allowed free escape for all secretions, during many of the earlier days of its sojourn. Its surface then was smooth and unirritating. Its hardness and impenetrability and insolubility gave no chance for corrosion or for the growth of bacteria. The collar button on removal was found to be crusted with salts in places and the surface of the uncrusted portions had less luster than a new button of the same kind. It seems probable that but little irritation of the bronchi took place until incrustation of the foreign body took place and made it mechanically irritating, resulting thus in introduction of the bacteria beneath the epithelial barrier. Possibly prior to this time there may have been sufficient local reaction to result in destruction of cilia and in enough swelling to interfere with escape of secretions past the intruder. Be this as it may, the fact remains that this glass collar button was present in the lung of Mrs. K. for a longer period (26 years) than is recorded in any other case in the history of medicine. The patient though seemingly moribund on admission, is alive and well today almost 30 years after the original accident. An isolated case is insufficient even for broad conclusions, but the case is in such marked contrast to many others herein referred to, in which other kinds of foreign bodies were concerned, that we feel warranted in the conclusion stated at the beginning of this paragraph. The slight and strictly localized reaction of glass was noticed in many instances of glass-headed shawl pins, and notably in the case of the "teddy-bear" eye. (Case Fbdy. 583. See Figure 6, Plate II.) The œdema of the larynx in Case P. E. 341, present after 6 days, was probably due to the incision of the mucosa by the thin sharp edges of a Bohemian Christmas tree ornament. Wounding of the mucosa, of course, introduces the bacteria beneath the epithelial barrier; and, moreover, the subglottic tissues of an infant are exceedingly prone to develop œdema on the slightest provocation.



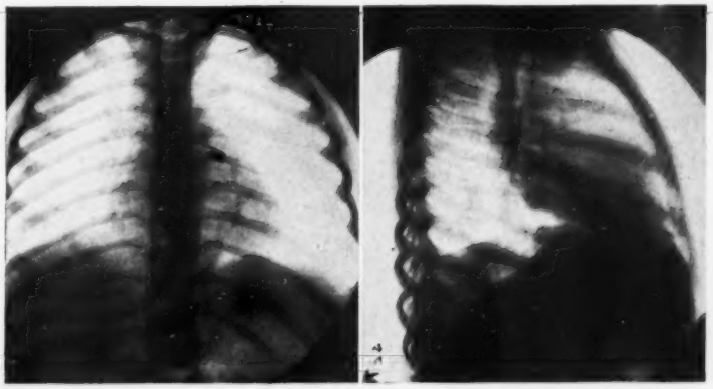
Roentgenogram 1. Case No. Fbdy. 394. Shawl pin in left bronchus of an infant aged 18 months.

Roentgenogram 3. Case No. Fbdy. 619. Safety pin very low in left lung of a girl aged 15 years.

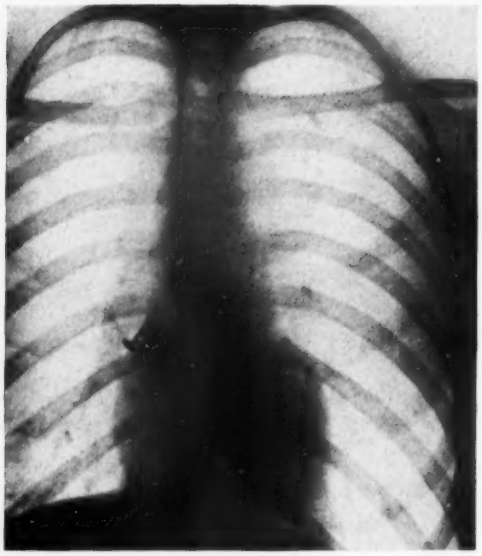
Diamonds were encountered only in minute settings in jewelry so that no distinction could be drawn between any possible reaction caused by them and by the metal in which they were set.

Anthracite coal was embedded in a ring of annular œdema but, as it had been drawn in by negative pressure due to subjacent air absorption, the œdema was probably from the pressure on the mucosa of the bronchial wall.

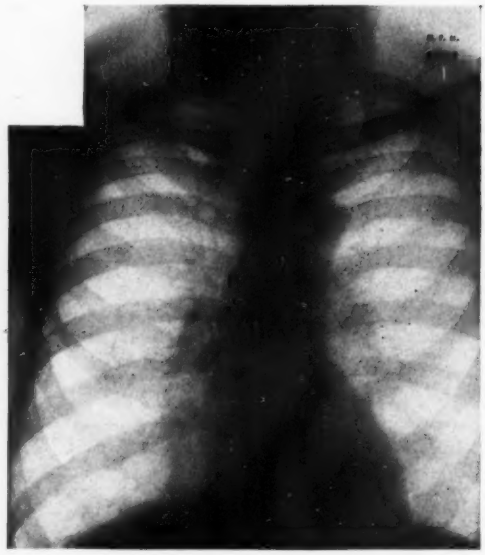
Bone. It is a very remarkable thing that so septic a thing as a piece of cancellous bone can remain in the lung for a period of 11 years and not produce a fatal degree of sepsis. For instance, in Case 608 (Figure 14, Plate II), a piece of cancellous bone, inhaled while eating soup, had in 11 years set up a septic bronchitis, perichondritis, stricture and bron-



Roentgenogram 2. Case No. Fbdy. 617. Portion of safety pin in left bronchus of a girl aged 3 years.



Roentgenogram 4. Case No. Fbdy. 382. Upholstery tack in middle lobe right bronchus of boy aged 18 years. Sojourn about 7 months. Note pathologic shadows over middle lobe area.

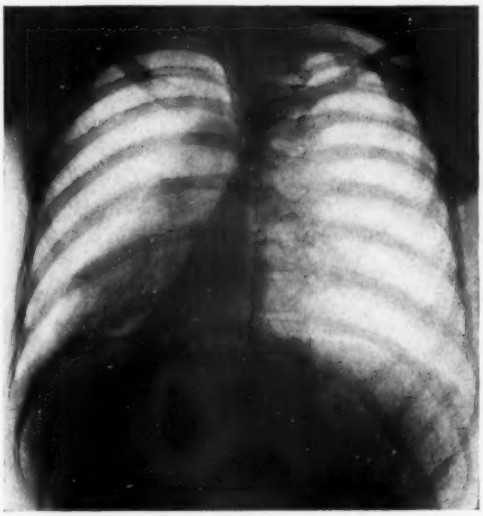


Roentgenogram 5. Case No. Fbdy. 611. Atomizer tip in right bronchus 1½ years. Patient aged 58 years.

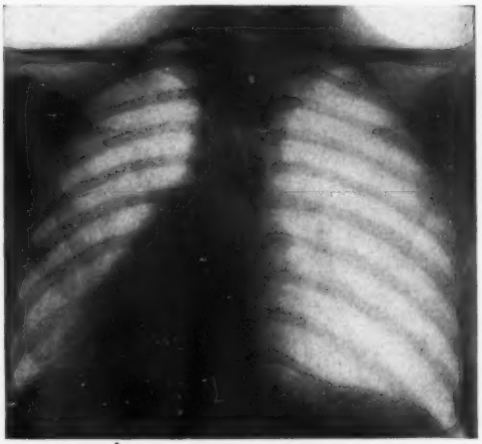
chiectasis. Yet this boy inhaling the bone at 9 years of age grew and developed, though constantly an invalid, for 11 years. For 7 months before I removed the bone the boy had been in bed outdoors for supposed tuberculosis. One of the most remarkable things about the case is that under the antituberculous régime the boy increased 15 pounds in weight. This is in marked contrast to the rapidly fatal bronchopneumonia set up by nut kernels, corn (maize) and the like, in the bronchi of children.

Roentgenogram 6. Case No. Fbdy. 410. Nail in right lung of boy aged 11 years. Probable sojourn 9½ years. Note shadows in right lower lobe posteriorly.

Meat in all cases was cooked. Hence it probably contained chiefly or exclusively the bacteria harbored by the patient, and to which the patient was probably more or less immune. Meat, even when putrid, as it was in most of the œsophageally-lodged cases, seemed to have set up practically no reaction. The most that could be noticed was only a slight congestion and this only in a few cases. In no case was there local inflammation, nor was there general reaction to indicate ptomaine absorption. In one case a spicule of bone in the meat had caused a wound, around which was a small inflammatory areola. The duration of sojourn was not longer than a few days in the purely meat cases; but the bones

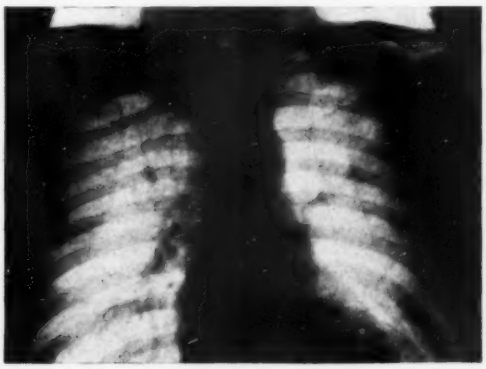


Roentgenogram 7. Case No. Fbdy. 444. Triangular shadow shows area of "drowned lung" due to "corking" of a bronchus by a peanut shell in a girl aged 8 years.

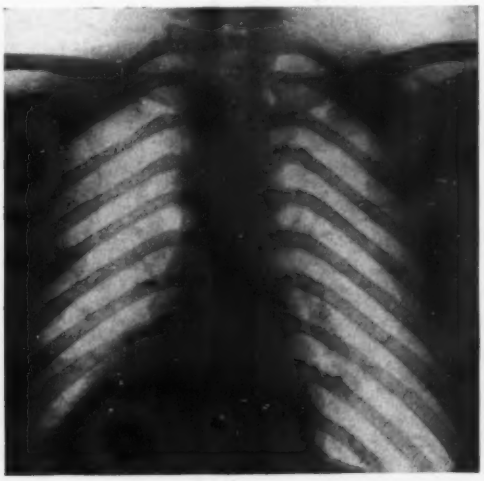


Roentgenogram 8. Taken two days after removal of peanut shell in case No. Fbdy. 444 shows complete evacuation of the "drowned lung."

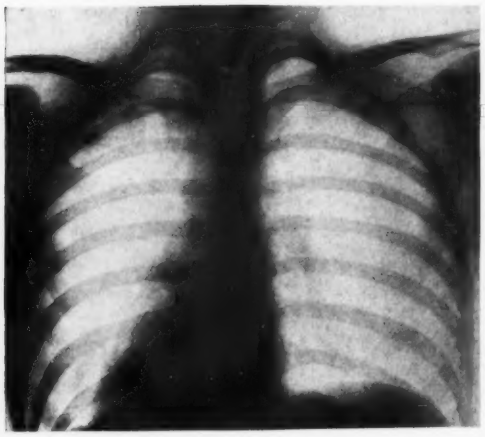
with periosteum, etc., attached, were present in a few instances for a number of weeks in the œsophagus. In the air passages the maximum sojourn of bones was 11 years (Case Fbdy. 608). Whether or not, softer tissues were originally attached could not be determined in any of the long duration cases; but in cases of less duration, putrid soft tissues did not seem to have given rise to any special degree or extent of reaction, certainly no more than bone alone excited in other cases. In no case were there symptoms similar to ptomaine poisoning following gastro-intestinal ingestion. This is rather remarkable in view of the violence of such symptoms in some instances. Possibly the relatively small quantity might have been a factor.



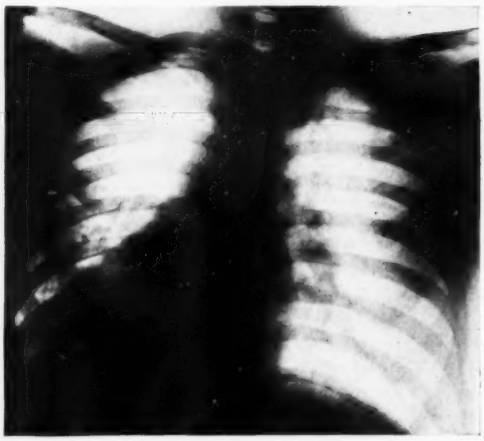
Roentgenogram 9. Case No. Fbdy. 409. Large fence staple in left bronchus of a man aged 43 years. Present 2 years.



Roentgenogram 10. Case No. Fbdy 552. Dental root-canal reamer in left upper lobe bronchus of a man aged 30. Sojourn about 3 months. Pathologic shadows absent.



Roentgenogram 11. Case No. Fbdy. 574. Amalgam tooth-filling in left bronchus of a woman aged 26 years.

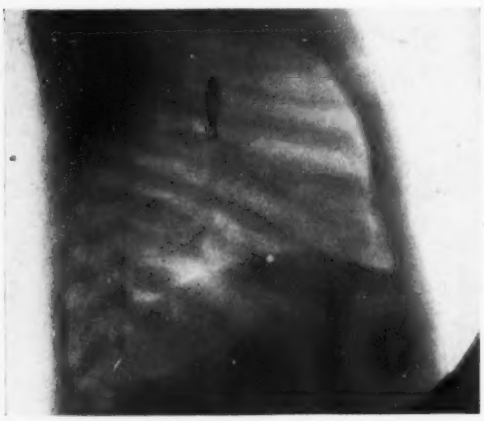


Roentgenogram 12. Case No. Fbdy. 440. Lead alloy collar button in left lung of a boy aged 14 years. Probable sojourn about 10 years. Note extensive pathologic change in left lower lobe. Compensatory emphysema of right chest.

Wood in two cases seemed to have set up a high degree of inflammation. In one of the cases, however, a small fragment of soft rubber was attached and might have been a factor.

Rubber. The tissues of the air passages seem quite tolerant of vulcanite, or hard-rubber. To soft rubber, however, the reaction seems quite violent. This was shown in two recent cases and most remarkably in the following case:

Case Fbdy. 622. Man, aged 36 years. History of convulsive seizures. One year ago began having short, generalized convulsive seizures which occurred always at 5 a.m. and during which he would bite the tongue. Attacks first occurred every 5 or 6 weeks; later they became more frequent until they occurred on successive mornings. A diagnosis of epilepsy was made. He was examined by various physicians, one of whom gave 6 intravenous injections of a "German medicine which cost ten dollars for each treatment." (Salvarsan?) He also received mercury tablets. Under this treatment the attacks diminished in severity and duration and became less frequent. The last attack occurred 5 weeks ago.

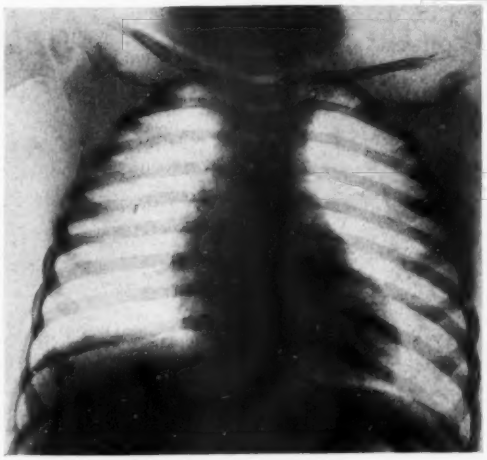


Roentgenogram 13. Case No. Fbdy. 553. Brass foot of an alarm clock in left main bronchus of child aged 21 months.

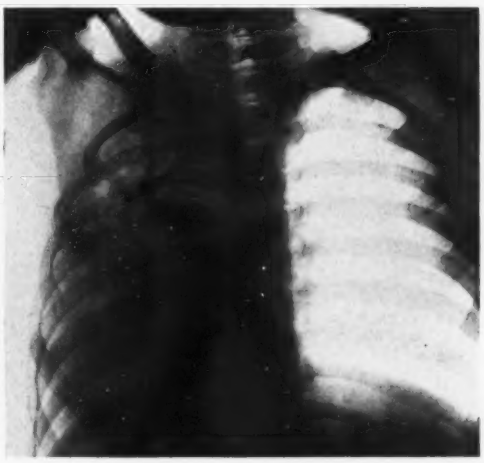
Present illness. Seven months before admission the patient had a convulsive attack during which a stenographer's eraser was inserted between his teeth to prevent injury to the tongue. The patient bit off a portion of the eraser, the piece being immediately aspirated. This was followed by much choking and coughing with failure to dislodge the foreign body. He was told by a physician that he had swallowed the piece of eraser.

The patient continued to cough and wheeze and was told by a second physician that he had asthma. A third consultant had roentgenographic plates made and stated that the portion of eraser had lodged in the right bronchus. Three weeks later an unsuccessful attempt to remove it by bronchoscopy was made by a physician in the patient's native city. Another series of plates made failed to show the foreign body. The patient was then told he had asthma.

The patient has wheezed and coughed ever since. He lost 19 pounds in the last two months. Once he spat a small amount of blood and was told he was



Roentgenogram 14. Case No. Fbdy. 583. Glass eye of "Teddy bear" in right lung of child aged 2 years.



Roentgenogram 15. Case No. Fbdy. 572. Cap off brass bedstead in the right bronchus of boy aged 9 years. Probable sojourn about 2 years. Note dense pathologic shadow in right chest and compensatory emphysema in left.

tuberculous. Repeated sputum examinations were negative for tubercle bacilli. A third series of roentgenographic plates made by another roentgenographer, Dr. Farley, showed the presence of a foreign body and the patient started for Philadelphia.

On the train he became very dyspnœic and cyanotic, feverish and very feeble. He arrived in Philadelphia in very poor condition. He was brought to the hospital in an ambulance. Temperature on admission, 103.3°, pulse 140, and respirations 52, maximum. H. A. Hare and E. Quin Thornton both saw the patient and diagnosticated bilaterial pneumonia with gangrene and multiple abscess formation. The patient was apparently dying. Under stimulation as advised by H. A. Hare, the patient recovered consciousness, took some nourishment, and went through the last religious ceremony.

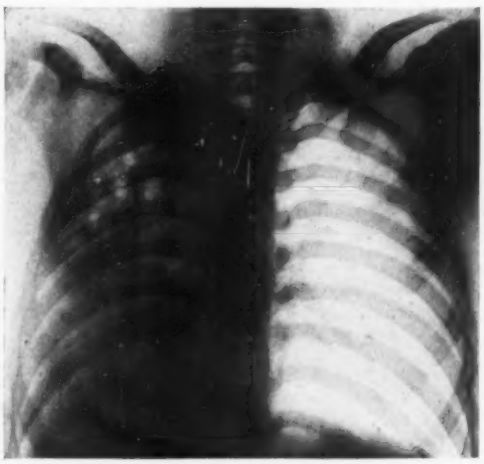
His pulse became very weak. He failed to respond to stimulation. Respirations became very shallow and labored, and ceased.

Autopsy. (Submitted by E. D. Funk.) The body is that of a well developed, adult, white male. Rigor mortis is present but easily broken up. Postmortem suggillation posteriorly and over upper anterior chest wall. Pupils are equal and normal in size; conjunctivæ, slight yellowish tinge.

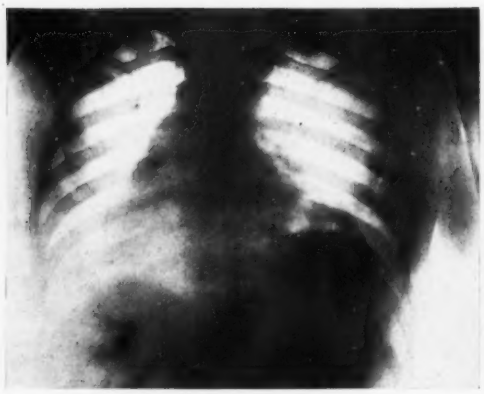
Abdomen quite prominent, particularly in upper left quadrant. No external evidence of any injury.

Peritoneum is smooth and glistening. Cavity contains only a few cubic centimeters of clear yellowish fluid. Great omentum is well supplied with fat and covers the intestines in lower abdomen. Appendix measures approximately 7 centimeters in length and is free except at the tip which is bound down by adhesions. Liver extends 3.5 centimeters beyond costal margin in midclavicular line and 6.4 centimeters beyond ensiform cartilage. Diaphragm is at upper border of fifth rib on left. Stomach greatly dilated, the pylorus sagging to level of umbilicus.

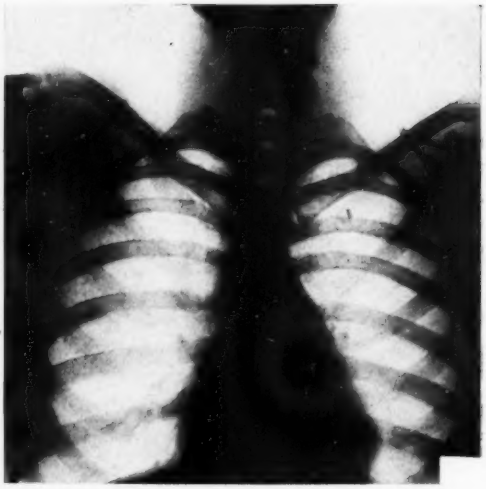
Left pleural cavity contains a normal quantity of slightly turbid fluid. Serosa over lower lobe is covered by a thin granular, grayish film of exudate.



Roentgenogram 16. Taken immediately after removal of brass cap in Case No. Fbdy. 572. More air seems to be entering all parts of left chest.



Roentgenogram 17. Case 266 P. E. Woman aged 23 years. Brass paper fastener in right lung.



Roentgenogram 18. Same case as in Roentgenogram 17 7 years after peroral bronchoscopic removal of brass paper fastener that had been in the lung 7 years. There are no more pathologic shadows than are usual in the average individual of the same age.

Left lung weight 770 grams. Pleural surface is uniformly smooth except at base which is hyperæmic and covered by an exudate. On section the entire lung is œdematous and congested, especially at base. Margins of upper lobe are light in color and emphysematous. In lower lobe the bronchi are inflamed and many contain rather thick, dark, frothy material. Along the course of these bronchi and bronchioles the lung tissue is darker and softer than elsewhere. This tissue contains discrete grayish hard areas about the size of a pin-head; they are definitely circumscribed and surrounded by a faint reddish zone.

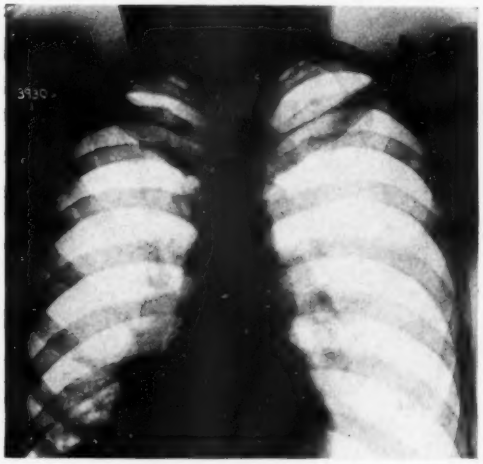
Right pleural cavity contains an excess of turbid flocculent fluid. The lining — both visceral and parietal — is covered by a thin grayish exudate below the level of the third rib.

Roentgenogram 19. Case No. Fbdy. 630. Shoe button in left bronchus of girl aged 12 years. Probable sojourn 6 months.

Right lung weighs 1570 grams and is somewhat voluminous. The trachea, 6 centimeters above the bifurcation, measures 3 centimeters in diameter; just above the bifurcation the left bronchus measures 2 centimeters. The right bronchus is 3 centimeters in diameter. The mucosa of the trachea is swollen and almost black in color. Pressure upon the lung causes a foul smelling material to exude from the trachea. Section of the lung reveals many abscesses of various sizes and shapes, most numerous in the middle and lower lobes and situated in groups along the course of bronchi and bronchioles. Here many have coalesced and contain soft necrotic centers. The bronchial mucosa is swollen and the bronchi are filled with mucopurulent exudate. In the lower lobe where the lung is black, very soft and friable, a distinctly gangrenous area may be seen. Bronchial lymph-nodes are abundant, enlarged and œdematous.

The pericardium is smooth and glistening. The cavity contains a small amount of clear, deep yellow serum.

The heart weighs 327 grams and measures 15 by 11 centimeters. The wall of the left ventricle measures 2.6 centimeters in thickness. The myocardium is dark red, firm and congested. The right side of the heart is dilated and the cavities are filled with dark red clots. The valves and orifices of the left side apparently are efficient. On the anterior leaflet of the mitral valve are two yellowish raised



Roentgenogram 20. Case No. Fbdy. 608. Bone in right bronchus of boy aged 20 years. Probable sojourn 11 years. Note pathology in right lower lobe.

areas. Two aberrant chorda tendineæ span the cavity of the left ventricle. The foramen ovale is close.

The spleen weighs 175 grams and measures 14 by 9 by 3 centimeters. The organ is slightly enlarged, the capsule is smooth and free from adhesion. On section the pulp is firm and presents no gross lesion.

Adrenals, no macroscopic change.

The right kidney weighs 230 grams and measures 13.5 by 6 by 4.5 centimeters. The kidney bed is well supplied with fat. The capsule is smooth, thin, and easily stripped. An incision shows no change in the cortex except swelling and congestion. The ureter is single and patulous.

The left kidney weighs 220 grams and measures 12.5 by 6 by 4.5 centimeters. It presents same general appearance as its fellow. Ureter single and patulous.

Bladder, no gross change.

External genitalia apparently normal.

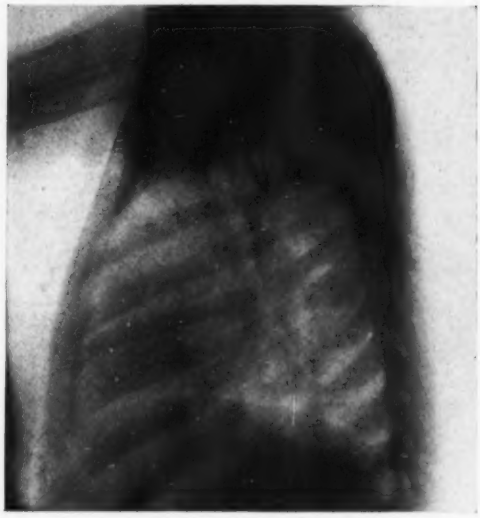
The liver weighs 1770 grams and measures 29 by 19 centimeters. The capsule is smooth and tense, the edges rounded. On section the liver is firm and dark red with yellowish mottling. The veins are full of blood. The gall-bladder extends 3 centimeters below the margin of the liver and contains a small amount of yellowish bile. The biliary passages are patulous.

The stomach is greatly dilated and partly filled with thin granular grayish material and air. The mucosa is flattened and smooth.

The pancreas weighs 100 grams and measures 18 by 4 centimeters. No lesion is discernible.

The aorta shows several raised grayish patches, most numerous at the arch.

The intestines show nothing noteworthy.



Roentgenogram 21. Case No. Fbdy. 578. Pearl shell ring in œsophagus of a boy aged 3½ years. Probable sojourn 1 year.

Gross diagnosis. Multiple abscesses of lungs, septic pneumonia with beginning gangrene, œdema and congestion of lungs, acute fibrinous pleuritis, dilatation of right heart and stomach, cloudy swelling of kidney and liver, congestion of myocardium, acute suppurative bronchitis and peribronchitis.

Bacteriologic diagnosis. Inoculations from the trachea yielded pneumococci, staphylococci, bacillus of Friedlander, streptococci, and a gram-negative motile organism which could not definitely be identified.

Microscopic diagnosis. Left lung, acute suppurative bronchitis and peribronchitis; acute suppurative pneumonia; septic pneumonia. Right lung, acute suppurative bronchitis, septic pneumonia; œdema. Heart, granular degeneration. Spleen, congestion. Liver, congestion; granular degeneration. Peribronchial lymph-nodes, acute non-suppurative lymphadentis. Kidney, slight congestion; cloudy swelling. Pancreas, normal. Adrenals, normal.

Coffee berry. We have had two instances of coffee berry, one roasted, the other not. Both were in children. The unroasted berry had set up a violent diffuse tracheobronchitis with a copious accumulation of pus. The roasted berry had caused a diffuse reaction; but of less severity.

Peanut kernels. Of all substances that we have encountered in our bronchoscopic ex-

Roentgenogram 22. Case No. Fbdy. 500. Lead weight in the œsophagus of a child aged 15 months.

perience, peanut kernels set up the most prompt and violent reaction. All of our peanut cases were in children. The younger the child, the more severe the reaction. In a number of cases, a peanut kernel in a few hours produced a diffuse general tracheobronchitis. Three cases in which we were not permitted to do a bronchoscopy died within 2 weeks. In Case 604, a child, aged 2½ years, showed violent tracheobronchitis with patches of exudate from a 6 weeks' sojourn of pieces of peanut kernel in the bronchi. Had the child been younger it is doubtful, from a clinician's point of view, if the child would have lived this long. Many similar cases are now in our case records, and while the degree of inflammatory reaction varies with the age of the child and with other and unknown factors, the evidence is sufficient to warrant the statement made at the beginning of this paragraph. In some of the cases the pus was so copious as to be coughed out, on insertion of the bronchoscope, onto the bronchoscopist's gown, dripping thence to the floor.

Observations on the reaction of peanut kernels have been solely in the trachea and bronchi, because no case of lodgment in the œsophagus has come under our observation.

Roentgenogram 23. Case No. Fbdy. 559. English half-penny (copper alloy?) in œsophagus of girl aged 4½ years. Probable sojourn 8 months. Lateral roentgenogram showing coin edgewise.

The only other nut kernel encountered as a foreign body was a walnut kernel. This patient (Case Fbdy. 425), an infant of 17 months, developed a most violent tracheobronchitis in three days' sojourn of the kernel. This similarity is the more remarkable since the so-called peanut is not truly a nut botanically speaking, whatever it may be chemically. Moreover, the walnut kernel was raw, whereas the peanut kernels were all, so far as known, cooked.

Hypothetical questions. Many hypotheses come to mind in comparing the reaction of different kinds of foreign bodies on the mucosal surfaces of the air and food passages. To attempt the solution of these problems by theoretic consideration would be to resort to the old theoretic "pathology" which kept medicine and surgery groping in the dark for ages. Most of these hypotheses are promising subjects for laboratory investigations and plans to this end are now under way. These will be reported upon later. The purpose of the present paper is to record the visual ob-

servations of living pathology. Recognizing the dangers of theoretic pathology, we are, however, justified in considering certain established facts in regard to the reaction of tissues to the presence of various substances. These will be alluded to briefly in connection with the various classes of substances.

When one notes the readiness with which certain substances are encysted in bacteria-free tissues, there is an unavoidable suspicion that bacteria are largely concerned in the wide variation in the degree to which different foreign bodies in the lower air passages cause reaction. This naturally brings up the questions:

What is the relative suitability of foreign bodies of various kinds to serve as carriers of bacteria? To what extent is such suitability a factor as compared to the after-service of the characters of the foreign body as a matrix, an occluder of drainage and aeration, a helper of bacterial growth, as a medium or otherwise?

Other general questions are: To what extent do certain foreign bodies facilitate penetration of bacteria through the epithelial barrier by means other than purely mechanical puncture and the atria resulting from the inflammatory outward migration of leucocytes? Can certain kinds of foreign bodies impair ciliary activity by means other than the excitation of inflammation?

Undoubtedly one of the factors in the pathologic processes is the impairment of ciliary activity. On how soon after the invasion the impairment takes place, in other words, whether the primary inflammatory processes stop or seriously lessen this activity, or whether it is in the later destructive inflammatory processes that the cilia are destroyed, bronchoscopy has as yet not thrown any light. Plans for working out this problem have been made.

The relative activity of the cilia in adults and children seems never to have been determined.

It may here be mentioned that previously reported bronchoscopic observations by the author[1] have established the fact that the flow of the stream of secretions under normal conditions is greatest up the posterior wall of the trachea and out the posterior commissure of the larynx between the right and left arytenoid eminences (Fig. 10, Plate I.)[2]

Previously referred-to bronchoscopic observations and cultural tests by the author have also established the fact that the mucosal surfaces of the bronchi are not absolutely and at all times sterile; but they are occasionally so, and the deeper (more peripheral) the location, the fewer the organisms. Doubtless, this is because under normal conditions, the organisms are swept out by the flow of sterile secretions poured out by the mucosal glands and propelled by ciliary, bechic, and forced expiratory action, voluntary and involuntary.

Hypothetical questions suggested by Dr. W. M. L. Coplin, upon which we hope later to have laboratory data, are:

1. Do metallic foreign bodies give off, in the process of corrosion, bactericidal products?

2. Are the vastly greater irritating properties of such substances as peanut kernels due to:

a. Irritating chemical substances present in the peanut, either naturally as the abrin in jequirity or ricin in the castor bean, or developed in the roasting process? Ricin is non-toxic when taken into the gastro-intestinal tract. (Jacob Rosenbloom suggested to me the testing of the possibly irritating properties of arachidic acid as an irritant. This saturated fatty acid is present in about 5 per cent strength in peanut oil.)

b. The contact of an alien protein with tissue not naturally accustomed to such substances, the alien protein not having previously gone through the mill of enteric and hepatic preparatory processes?

c. The protective matrix afforded by a porous organic vegetable protein for the growth of bacteria in a warm moist incubating chamber, such as the living bronchi, the bacterial growth giving off irritating toxins or acquiring virulence to enable the organisms to attack the living tissues?

[1] Peroral Endoscopy and Laryngeal Surgery. Textbook, 1914. Also Arch. of diag., April, 1908.

[2] At the suggestion of Dr. W. M. L. Coplin, the author has since made further observations by which it was discovered that the tendency of the endotracheal blood streak selected the posterior wall when the patient was standing or sitting erect, just the same as in a recumbent patient. In other words posture had no influence in the predilection of the endotracheal blood streak for the posterior wall.

3. Is the reaction to the presence of the peanut simply an unusually violent effort of nature to split up and get rid of a very complex alien protein by an unnatural route?

4. Is the relative mildness of the reaction from so septic a substance as a cancellous bone, as compared to a peanut kernel, explainable upon the basis of the well-known toxic properties of alien proteins?

Cough as an aid to ciliary activity is important. Bechic inefficiency in infants and young children as compared to adults, in whom voluntary expectorative aid is a large factor, has been demonstrated by the author (3). Possibly this is one of the factors leading to the greater vulnerability of children to the reaction of foreign bodies.

LOCATION OF LODGMENT OF FOREIGN BODIES IN THE BRONCHI

A distinction must be made between the location of primary lodgment and of ultimate lodgment. The latter term must be used with reservations, since, if the patient lives, nearly all bronchially-lodged foreign bodies migrate continually downward and outward toward the periphery of the lung, at first as far as the size and shape of the intruder, relatively to the size and shape of the bronchi, will permit. Later, pathological processes fix the foreign body. Still later the intruder may ulcerate loose and migrate farther toward the periphery, but this is relatively very rare. Usually the intruder remains fixed in inflammatory tissue, while the subjacent purulent processes migrate toward the pleural cavity into which they often enter, causing a pyopneumothorax. In only one of our cases that came in with this condition had the foreign body followed the pus into the pleura. In none of them had the intruder worked its way through an area of adhesive pleuritis to the skin surface but such cases have been recorded in the prebronchoscopic days.

Foreign bodies often lodge in the larynx. These instances were chiefly in the case of large, long, or sharply pointed substances, lodgment taking place because of a point sticking into the walls or into the ventricles. In a few instances lodgment was due merely to size. In more than half the cases that came in with foreign bodies in the bronchi there was good reason to believe that the intruder had first lodged higher and had been dislodged by natural reflexes or by efforts at removal, especially ill-advised efforts in the upright posture.

Nothing new, statistically or otherwise, has developed to lead me to alter the statement previously made (1) as to the greater frequency of right-sided lodgment and reasons therefor, the rarity of middle-lobe lodgment, the influence of size, shape, specific gravity and other characters on lodgment, nor as to the rarity of spontaneous expulsion. Further observation corroborates the fact then noted that lodgment is almost always at or below the orifice of a branch bronchus; because, probably, of the fact that the bronchi do not diminish in diameter taperingly between branches. The branching is of monopodic type and the interramal parts of the bronchi are relatively cylindrical. The most frequent site of lodgment, as shown in earlier observations, is at, or immediately below, the giving off of the right upper-lobe bronchus, usually far enough below to permit air to enter the upper-lobe bronchus over the top of the foreign body. The next most frequent site is the corresponding anatomical location on the left side. Next in order of frequency are the stem bronchi, first the right then the left. The dorsal branches of either side are much more frequently invaded than the ventral branches, the most frequent of all being the large posterior branch of the left inferior-lobe bronchus that is given off immediately below the left upper-lobe bronchus. The data bearing on this subject have already been published (1).

Participation of the other lung in the bronchitis of foreign-body origin does not usually occur in recent cases except when the intruder is of the extremely irritating class, such as peanut kernels and maize. In these, diffuse bronchitis of both lungs is the rule, so much so that the bronchoscopist is deprived of one of his best guides for finding the location of the foreign body: namely, the evidences of pathology at or near the orifice of the particular bronchus invaded. The evidences of inflammation are not localized in such cases

as they are in metallic bodies for instance. In case of metallic and other mineral bodies present for a long time, there is usually a mild degree of chronic bronchitis in the other lung due, doubtless, to the secretions getting over from the invaded lung during sleep and at other times when the cough reflex and the ciliary activities are lessened. The same is true of bones and of all inorganic substances. But in all of the cases of substances other than the irritating class (nut kernels, maize, etc.), the evidences of pathology are relatively so slight that there is no trouble in going directly to the invaded bronchus by following the signs of pathology, provided the intruder has been *in situ* sufficiently long to produce marked pathologic changes.

Tissues involved in the reaction to the presence of a foreign body. It is logical to suppose that, primarily, the lodgment of a foreign body in a bronchus produces a reaction limited to the mucosa. Many foreign bodies, owing to impact on aspiration of the foreign body, or on its being knocked about, or by the friction caused by respiratory, pulsatory and bechic movements, perforate the mucosa, introducing the bacteria and attendant inflammatory processes into the perichondrium, the cartilage, the interannular tissues, the vessels and all the tissues composing the parenchyma of the lung.

CAUSES OF REACTION OF BRONCHIAL TISSUES TO THE PRESENCE OF FOREIGN BODIES

It is probably justifiable to assume that the causes of the reactions of the mucosal and adjacent tissues to the presence of a foreign body may be classified as mechanical, chemical, biomechanical and biochemical.

Mechanical causes of reaction of the tissues to the presence of foreign bodies. These are easily understood and admit of little dispute. Direct trauma of a foreign body by the impact of its striking when it is aspirated with projectile-like force, assisted or not by gravity, is easily understood. So also is the puncture of the epithelium either on the impact or later as a result of the chafing due to the to-and-fro excursion of the contactual bronchial wall in the respiratory, bechic, and pulsatory movements which are continuous. As previously pointed out by the author, long objects pointed at one end only, such as pins, tacks and the like, have a ratchet-like movement by which they work downward to the lowest possible location, due to the prevention of upward return by the sticking of the point into the lateral wall. The axis of the foreign body not coinciding with the bronchial axis because of the relatively large diameter of the latter, the point, which is almost invariably upward, sags over into contact with the bronchial wall, into which it penetrates during the subsequent longitudinal shortening of the bronchus during expiration, cough, or transmitted cardiac or vascular impulse.

Under mechanical processes may also be included the occlusion or "corking" of a bronchus by which drainage and aeration of the subjacent tributary lung is interfered with. This obstruction may be contributed to by swelling of the tissues, swelling or corrosive increase in the bulk of the foreign body.

Biomechanical processes may include: (a) the irritating roughness induced in a foreign body by corrosion and by the incrustation of a foreign body secondary to tissue reaction; (b) the swelling of the foreign body due to the absorption of the ever-present secretions, normal or pathologic, resulting in great lateral pressure; (c) the increase in bulk of the intruder by corrosive processes; (d) the swelling of the bronchial wall, obliterating the airways that on first invasion existed at certain points between the foreign body and the bronchial wall, due to irregularities in the shape of the foreign body.

Chemical processes include those in which the intruder contains material which is directly irritating to the tissues.

Biochemical processes. In this classification might be included the reactions on the tissues produced by irritative agents developed by bacterial or tissue-cell activities.

Age in relation to reaction of tissues to foreign bodies. Our observations show beyond doubt that the larynx, trachea, and bronchi of infants react much more severely and generally to foreign bodies than those of adults. This is especially true of the subglottic region in children aged less than 19 months. Their

subglottic tissues will swell until in the most severe cases they meet in the middle line and will asphyxiate the little patients unless a tracheotomy be done to supply air until the subglottic œdema subsides. Peanut kernels seem peculiarly liable to set up this subglottic swelling. Subglottic œdema in infants, is however, not peculiar to foreign-body cases. We have often seen it in acute laryngo-tracheitis commonly called "the grippe" or broncho-pneumonia. In quite a proportion of the cases of laryngeal and tracheal diphtheria in infants, in our observation, it is often this subglottic œdema rather than the bulk of the membrane that necessitates tracheotomy or intubation. Logan Turner has shown the peculiar histology of the subglottic region in children; and, doubtless, structure is the chief factor in the tendency to subglottic œdema in infants. Our youngest patient was 11 days old.

Contact reaction. The mere contact (without impact) of a foreign body in the trachea or bronchi seems to cause very little reaction. In Case Fbdy. 557, the needle in contact with the mucosa, after it had been in the lower air passages for 2 hours, had caused only a slight congestion. This seemed to be the case in most instances of metallic bodies of short sojourn though none was quite so short as that of the needle. In a number of peanut cases of very short sojourn a diffuse general reaction was set up. The mechanical irritation of contact of a peanut would theoretically seem much less than that of a metallic body. The reaction from contact of the bronchoscope in a careful, gentle bronchoscopy seems very slight, and successive introduction of the instrument shows that the slight congestion caused very quickly disappears, provided no abrasion of the epithelium has occurred. The reaction from improper, rough, violent use of the bronchoscope as shown in Figure 3, Plate I, is followed by more or less severe traumatic bronchitis.

The slight reaction from mere contact observed endoscopically corresponds to clinical findings. When each one of us recalls the violent choking and strangling excited in ourselves by a mere crumb of bread that has "gone the wrong way" we really refer only to laryngeal sensations. Strange as it may seem, the deeper passages are quite tolerant for foreign bodies. In most instances after the coughing and choking excited by the presence of the foreign body while passing through the larynx, practically all cough ceases. It is this deceptive and little-known period of quiescence that deludes patient and practitioner into believing the foreign body could not have entered the lung. In Case Fbdy. 409 (Figure 8, Plate II), the family physician when called immediately after the accident said: "Impossible. You would have been dead in 5 minutes and would have been coughing your head off the whole time."

CASES OF PROLONGED SOJOURN OF FOREIGN BODIES IN THE AIR PASSAGES

Of the 23 cases in which the foreign body had been in the lung for periods ranging from 3 months to 18 years, the clinical signs of pulmonary sepsis supervened and the patients developed the clinical picture of pulmonary tuberculosis; yet in not one of the 23 were tubercle bacilli found, though repeated examinations were made. Moreover the relatively prompt and complete recovery of the patient in 16 out of the 23 cases clinically substantiated the bacteriological findings. It seems, therefore, that the statement that appears in many textbooks that cases of foreign body in the lung are prone to die of pulmonary tuberculosis is a relic of the days when the diagnosis of tuberculosis was made upon clinical, and not upon the bacteriological, or even pathological data.

The predominant characteristics of the pathologic processes of the 23 cases of prolonged sojourn of a foreign body in the bronchi were:

1. Foul and dark-colored or greenish pus indicating the presence of saprophytes and chromogenic bacteria.
2. Presence of an abundant bacterial flora, without distinctly predominant varieties of organisms.
3. Absence of bacillus tuberculosis.
4. Presence of a stricture of the bronchus, the foreign body occupying the lumen of the stricture in 16 out of the 23 cases.

5. The presence of a cavity varying from a slight dilatation of a bronchus to an abscess cavity, though in most instances the "cavity" was filled with granulation tissue and usually its walls were collapsed. In some instances the cavity gaped on inspiration after removal of the foreign body and bronchoscopic aspiration of the pus; in one instance the "cavity" was inflated with the caisson bronchoscope (Figure 9, Plate II).

6. The location of the foreign body at the upper part of the pathologic mass. In all save two of the 23 cases of prolonged sojourn of a foreign body in a bronchus, the foreign body was located at the upper part of the diseased tissue which has resulted from its presence. In the cases in which cavities of abscessal or bronchiectatic character had resulted, the foreign body was, in all cases but two, located in a stricture at the top (or proximal end) of the cavity.

Pus and secretions in foreign-body cases. Systematic laboratory work has, unfortunately, not been carried out in all cases. The cases that were investigated, however, revealed the same organisms and the same tendency to mixed infections that are found in other inflammatory states of the bronchial mucosa. Pure cultures of one organism were not found in any instance. The specimens, so far as studied, showed, in the cases of prolonged sojourn, the same histologic and bacteriologic elements as are found in bronchiectasis and lung abscess. It is unfortunate that this abundant opportunity for investigation of these relatively rare conditions was not taken advantage of for systematic and thorough laboratory work. Arrangements are now made to do better in the future. Clinically the secretions of relatively recent cases were mucopurulent in character, often tinged with blood. In the peanut cases (all children) the mucopus, in most instances, was pinkish in color. In all the cases of prolonged sojourn the pus was characterized by being of very foul, stale odor. Usually the color was rather dark and somewhat greenish, rather thin than thick, not creamy. In some cases it was rather stringy. As soon as sponging was commenced in the procedure of bronchoscopy the oozing of blood from the granulations made the pus bloody to the extent that all other characteristics were lost, except the odor which persisted most obtrusively. In many of the cases of peanut kernels, maize, etc., the pus (often of "laudable" character) was coughed out as soon as the bronchoscope was inserted, in such copious quantities as to drip from the bronchoscopist's gown to the floor.

DROWNED LUNG AND LUNG ABSCESS

It is my custom always to take a roentgenograph of the chest after the removal of the foreign body for comparison with the one taken before the bronchoscopy. This has led to the discovery that much of the opacity of the subjacent lung tissue in recent cases disappears after bronchoscopy, evidently due to the usual bronchoscopic "sponge-pumping" out of purulent secretions. In cases of prolonged sojourn of the foreign body in the lung the same thing is noticeable but, to a less degree, and there still remains, in the latter class of cases, much opacity as compared to the other side. Possibly part of the contrast of the two sides is due to compensatory emphysema of the uninvaded side; but allowing for this there is unmistakable opacity. In the course of years (ranging from 1 to 10 in our records), the shadows almost entirely disappear, though traces may be visible long after all symptoms have disappeared and all physical signs have become normal.

When the drainage from a bronchus, large or small, becomes obstructed the secretions accumulate below and we have the natural passages filled with secretions which are, or soon become, purulent. This condition we have fallen into the custom of referring to as "drowned lung." It may give the same note as an atelectatic area and the two conditions may co-exist. Clinically it differs from true abscess in that it may develop rapidly, within a day or two in some instances, and in that if relieved at once by removal of the foreign body, recovery from whatever local reaction may be present is almost always prompt and complete. If, however, the area of "drowned lung" is not relieved by removal of the foreign body from the bronchus, the bacteria become

active in the pent-up secretions; the saprophytes decompose the secretions; the toxins and other products of bacterial activity, together with the inflammation, result in destruction of the cilia, the epithelium, then the subepithelial tissues, and the perichondrium; the cartilage itself dies and we have a cavity. Across one such "cavity" there stretched a band of tissue, which had an appearance of branching (Figure 9, Plate I). As to the nature of this band it is impossible to say. It may have been cicatricial tissue left during the shifting from some previous stage in the course of the inflammatory changes in the reaction of the tissues to the presence of the foreign body. It seems more probable, however, that it was some of the natural tissues more resistant than the others to the pathologic processes. Its form suggested a small branch bronchus, though the author's experience with purulent processes about the larynx is that perichondrium and cartilage are very prompt to become involved and break down under purulent processes. The interior of the abscess wall in the case with the band, was lined with large mushy, flabby granulations which entirely filled the cavity. Possibly this apparent filling may have been due in part to collapse of the walls. Be this as it may, the interior could be explored only by "caisson bronchoscopy," a method devised by the author for endoscopically inflating lung abscess cavities during examination. This case and the method have been previously reported. In the absence of autopsies it has been impossible to determine, by bronchoscopy alone, in every case, whether an observed hollowness constituted an abscess cavity or a bronchiectasis. The region below the stricture that held the foreign body was, in every case of prolonged sojourn, lined with bleeding inflammatory tissue, endomacroscopically resembling granulation tissue. In some of the cases in which there had been relatively free drainage around the foreign body, in the interstices between it and the bronchial wall, the latter, more or less altered by chronic inflammation, was visible in certain portions of the visible field. As near as the author has been able to determine, the condition has been one of bronchiectasis in 10 cases, and of abscess properly so called in 6 out of 23 cases of prolonged sojourn of foreign bodies in the lung. In the other 7 cases, no conclusion as to which to call the condition could be arrived at bronchoscopically. Foreign-body abscesses have been known to have a tendency to rupture into the pleural cavity or the mediastinum.

Drowning of the patient in his own secretions. In the foregoing paragraphs reference is had only to the drowning of sections of lung. The author (3) has previously called attention to the fact that glottic impairment can cause the bronchi and trachea to fill up until the patient will actually drown in his own secretions. It is a true drowning in the sense that fluid by its presence mechanically prevents atmospheric air from reaching the capillaries of the air cells. This condition has arisen in our foreign-body cases chiefly in children, whose subglottic tissues for anatomical reasons are peculiarly susceptible to œdema. This œdema occurred in 3 classes of case:

1. Those in which a loose foreign body had been knocked about in the trachea by cough.
2. Those in which the foreign body was of such peculiar character or accompaniments as to have excited a very violent diffuse reaction in the tracheobronchial tree.
3. A foreign body so jammed in the glottis as to prevent glottic closure in the bechic cycle.
4. One adult patient who had a recurrent paralysis before the foreign-body accident.

The mechanism of bechic expulsion of secretions (or anything else) is briefly:

1. The taking of a deep breath, filling the lungs with air.
2. Tight closure of the glottis.
3. Contraction of the expiratory muscles to raise the air pressure.
4. Sudden opening of the glottis, releasing the compressed air and gases in the chest.
5. Outward rush of the blast of compressed air and gases through the bronchi, trachea, larynx, fauces and mouth, the blast carrying with it secretions and foreign bodies with a varying degree of efficiency.

The efficiency depends, as one of its chief phases, upon free glottic movement, as well

as upon glottic patulency. If the glottis cannot close tightly preliminary compression of the intrathoracic air is impossible, so that the outward rush lacks suddenness, hence its efficiency as a secretion remover is lessened. If the glottic chink is narrowed so that its maximum exposure does not permit thick secretions to pass, the efficiency is impaired obstructively.

BRONCHIAL STENOSIS SECONDARY TO FOREIGN BODY

Recent cases. Bronchial stenosis in cases of globular or cylindric foreign bodies of more or less regular outline, so far as we could determine, resulted promptly from the wedging of the respective foreign bodies by impact in the smallest bronchus they could enter. Thus occluded, absorption of air took place in the tributary lung below, resulting in a negative pressure which forced the intruder farther and farther down. Then the inflammatory reaction in the neighborhood of the foreign body resulted in an annular œdema on the proximal side of the foreign body. Whether or not a similar condition existed below could not always be determined because in acute cases there was not often any justification for reinsertion of the bronchoscope after the removal of the foreign body. But the swelling on the proximal side, constituting, as it does, one of the difficulties to be overcome in the bronchoscopic seizure of the foreign body, was only too obvious. It was present in every recent case in which a cork-like occlusion of a bronchus had existed for a day or more. When a foreign body of somewhat irregular shape enters a bronchus, for a time the air can pass through the interstices left by the irregularities, as in Figures 6 and 12, Plate II. These interstices may be more or less occluded, if small, by this mucopus. If large, air and secretions may pass for a varying length of time, probably depending on the rapidity and intensity of the mucosal swelling which the particular foreign body may excite, the thickness of the secretions, the size of the bronchus, or, rather, the amount of cubical capacity of the subjacent lung on which depends the force of the respiratory and bechic blasts. A slender foreign body, such as a pin, located in a relatively large bronchus, had not resulted in bronchial obstruction in any of our cases short of 5 years. In Case Fbdy. 569 the exact time elapsed before obstruction supervened could not be determined; but occlusion was practically complete when the first bronchoscopy was done, 5 years after the aspiration of the pin.

Cases of prolonged sojourn. In all the 23 cases of prolonged sojourn of a foreign body in a bronchus there was more or less obstruction. This stenosis was composed of the foreign body plus the inflammatory sequelæ, cicatricial stricture, granulation tissue and purulent secretions, these various factors being present in varying degrees in the various cases.

Encysting of foreign bodies in the lung. Anthracosis concerns only relatively minute foreign bodies, which by reason of the small size reach the bronchioles and air cells. The author's observations concern only foreign bodies of relatively large size which necessarily occupy bronchi of a size not less than probably 3 millimeters in diameter. Such bodies probably rarely become encysted. If the bronchus closes proximally the locked-up bacteria and their pabulum form an abscess in most instances. In only two cases in the author's experience was a foreign body of size truly encysted and even in these the encysting may ultimately break down and result in abscess formation. There are five factors that probably contribute to prevent encysting of a foreign body in the lung.

1. Infection.
2. Patulency.
3. Epithelialized surfaces.
4. Movement.
5. Penning up of subjacent secretions, normal or abnormal, the passage of which maintains an open channel when forced upward either by bechic or accumulative pressure.

COLOR PLATES

The illustrations are reproduced by photo engraving from the original oil color drawings painted by the author from his sketches made immediately after the removal of the foreign bodies. They all represent the living tissues (except Figure 9, Plate II) as seen through the

laryngoscope, bronchoscope or œsophagoscope. Color always varies with the degree and character of the illumination and nowhere more so than in endoscopy. The light used by the author is of moderate intensity close to the tissues, at distal end of tube. For clearness the drawings are made to show appearances after the removal of secretions.

The effort is made to compare the effect of short and of prolonged sojourn of foreign bodies of the same character rather than isolated instances of all kinds of foreign bodies.

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NOTE.— The following publications are all written by the author and their listing here is intended only to enable those interested to find case reports, repetition of which has been omitted in this paper. No attempt has been made to review the literature. It has been deemed best to limit this paper to the recording of a relatively enormous endoscopic experience, for what it may be worth.

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BRONCHOSCOPIC AND ŒSOPHAGOSCOPIC VIEWS SHOWING THE PATHOLOGIC CHANGES FOLLOWING THE PRESENCE OF FOREIGN BODIES IN THE BRONCHI AND ŒSOPHAGUS

PLATE I

Fig. 1. Case Fbdy. 616B. Child, aged 7 years. Steel shawl-pin with head downward to left in left upper-lobe bronchus. Point lying in contact with median wall of left main bronchus. Peroral bronchoscopic removal. Cure.

Fig. 2. Case 269 P. E. Child, aged 12 years. Steel shawl-pin with head in left upper-lobe bronchus; point imbedded in median wall of left main bronchus. Endoscopic view 2 days after aspiration of pin. Peroral bronchoscopic removal. Cure.

Fig. 3. Case Fbdy. 394B. Infant, aged 18 months. Steel shawl-pin with head in left upper-lobe bronchus; point imbedded in median wall of left main bronchus. Pin probably *in situ* 35 days. Inflammatory state obliterating image of bronchial rings due to 2 previous rough bronchoscopies by an operator who was unable to see the pin. The grayish patch is exudate from improper instrumentation. Ordinarily reaction is only local around the buried point, as in Figure 2. That the baby survived the two previous rough, prolonged bronchoscopies is remarkable. Usually such work is fatal to infants. I have never seen such a reaction from either a metallic foreign body or a carefully done bronchoscopy. Peroral bronchoscopic removal. Cure.

Fig. 4. Case Fbdy. 577B. Girl, aged 7 years. Steel shawl-pin with head in left upper-lobe bronchus; point imbedded in median wall of left main bronchus, the pin being transfixed across the lumen of the bronchus. Observed 5 months after aspiration of pin, which is thickened and roughened by corrosion. Inflammatory state less than that of trauma from rough bronchoscopy in case shown in Figure 3. This illustrates the surprisingly little and the remarkably limited inflammation set up by a metallic foreign body in the bronchi. It is only in the immediate neighborhood that the rings are obliterated by the inflammation, which moreover, is essentially chronic. Peroral bronchoscopic removal. Cure.

NOTE.— Figures 1, 2, and 4 afford a noteworthy opportunity for comparison of the effect of a foreign body of precisely the same character (steel pins with glass heads) in about the same location, but of various durations of sojourn.

Fig. 5. Case Fbdy. 565. Girl, aged 8 years. Steel shawl-pin with head in left main bronchus, the point in tracheal wall above orifice of right bronchus. A tiny stream of blood is seen to be carried by the cilia toward the posterior wall of the trachea. (See also Figure 10.) Peroral bronchoscopic removal. Cure.

Fig. 6. Case Fbdy. 625. Man, aged 21 years. Dental root-canal-reamer (tool steel with brass handle) in middle-lobe bronchus, the point having entered slightly into the mucosa. Faint areola around point of entrance. (Compare Figure 11, in which a similar foreign body had been in a bronchus for 3 months.) Peroral bronchoscopic removal. Cure.

Fig. 7. Case Fbdy. 569. Woman, aged 63 years. Steel shawl-pin was aspirated 5 years previously, and probably entered a branch of the middle-lobe bronchus. The yellow patch on the mound-like swelling represents a mass of pus and exudate.

Fig. 8. Same case as in Figure 7. The pus and exudate have been wiped away, revealing the end of the much-corroded pin occupying the strictured orifice of an abscess cavity. This appearance of a foreign-body abscess cavity is not unusual but the mound-like protrusion into the lumen of the bronchus is rare.

Fig. 9. Same case as in Figures 7 and 8. Interior of abscess cavity. The orifice was dilated and the pin was removed, a caisson-bronchoscope has been inserted and the cavity ballooned for examination of its interior. The nature of the band stretching across from wall to wall was not determined. It might have been vascular, bronchial or cicatricial tissue. Pus was very foul. All expectoration ceased after a few weeks and the patient is still well at end of 2 years.

NOTE.— Comparisons of Figures 1, 2, 4, 7, 8 and 9 are interesting as they show the pathologic changes of

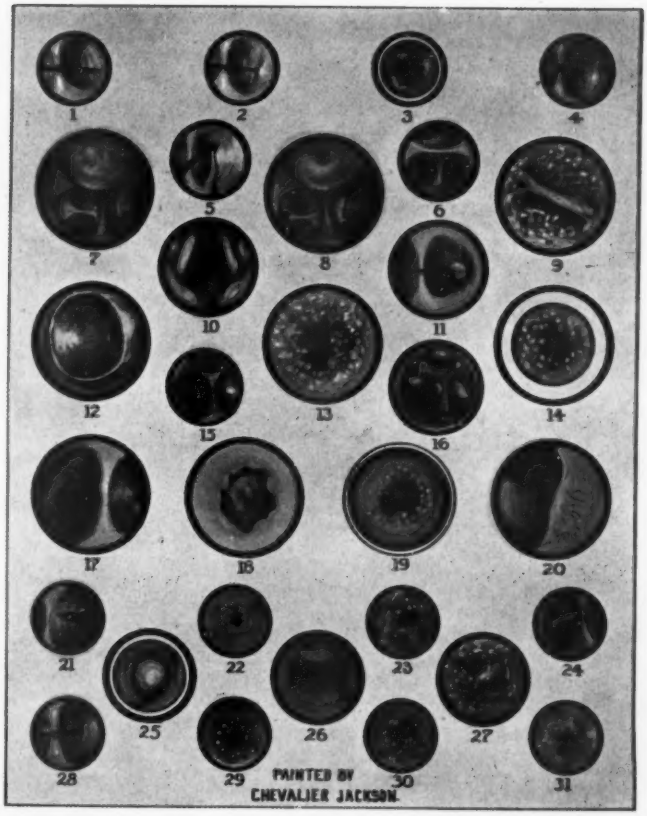
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PLATE I.

similar foreign bodies (steel pins with glass heads), present for various periods from 2 days to 5 years.

Fig. 10. Same case as in Figure 5. Tiny stream of blood is seen to be carried by the cilia up the posterior wall of the trachea and out the "pitcher mouth" between the arytenoids. This original observation of the author has been observed in previous and subsequent foreign-body cases. Occasionally it is seen in tuberculous cases. At intervals the cough removed the streak of blood; but it was soon replaced in cases in which the bleeding continued in sufficient and not too great amount. It was not noticeable in copious hæmorrhages.

Fig. 11. Case Fbdy. 552. Dental root-canal-reamer (tool steel with brass handle) in left upper-lobe bronchus for 3 months. The point has entered the wall of the main bronchus, the point of entrance being surrounded by an inflammatory areola. A small patch of exudate is adherent. The local and mild character of the inflammation is important. Compare Figure 6, which shows the endoscopic appearances in a case of only 2 days' sojourn of a similar instrument.

Fig. 12. Case 230 P. E. Man, aged 76 years. Nickel-plated brass atomizer tip in right stem bronchus 10 days. Inflammatory reaction localized, probably because the foreign body is not of very irritating character and owing to the hole in the distal end, it does not obstruct drainage. Nickel-plating tarnished but not corroded. Peroral bronchoscopic removal. Cure.

Fig. 13. Case Fbdy. 611. Man, aged 58 years. Nickel-plated brass atomizer tip in right stem bronchus 1½ years. The size, shape and position of this foreign body are precisely the same as in the preceding case. (See Figure 12, above.) The granulation tissue that obstructs the view into the interior of the atomizer tip has developed as the result of a 1½ years' sojourn. The granulations surmount a firm, fibrous stricture, which required bronchoscopic dilatation for the removal of the foreign body. Pus very foul. Perichondritis present. Nickeling entirely gone, brass much corroded. Peroral bronchoscopic removal. Cure.

NOTE.— The localized character of the inflammatory processes in the cases illustrated in Figures 12 and 13, is noteworthy and is probably due to the relatively unirritating character of the foreign body and to its form, which because of the opening at both ends did not greatly obstruct drainage.

Fig. 14. Case Fbdy. 572. Boy, aged 9 years. Brass cap from bedstead in right main bronchus 1 year and 9 months. The general shape and position of the foreign body are similar to Figure 12; but there is no hole in the distal end of the cap. The obstruction to drainage had caused much more extensive pathology in the right lung (shown by roentgenography and physical signs) as compared to the two preceding cases. Endoscopically the bronchi of the left lung were normal, and this was corroborated by the ray and the physical signs, both the two last indicating compensatory emphysema. The illustration shows a proximal fibrous stricture covered with granulations. The pus was copious and very foul. Brass much corroded.

Fig. 15. Case Fbdy. 439b. Boy, aged 6 years. Peanut kernel projecting from the orifice of the right upper-lobe bronchus, two days after the kernel was inhaled. Intense diffuse bronchitis, which is particularly noteworthy in comparison with the relatively mild and markedly localized inflammation resulting from the presence of foreign bodies other than vegetable substances and especially in comparison with metallic bodies, particularly steel. Peroral bronchoscopic removal. Cure.

Fig. 16. Case Fbdy. 584. Child, aged 5 years. Peanut kernels in middle-lobe bronchus and an anterior branch of the inferior-lobe bronchus, 4 weeks after the accident. Diffuse bronchitis, patches of exudate. The pus which was copious has been sponged away. The trachea and the bronchi of the other lung were also inflamed. A younger child would probably have succumbed in less time. Peroral bronchoscopic removal. Cure.

Fig. 17. Case 369 P. E. Man, aged 23 years. Bullet, probably chiefly lead, in orifice of left bronchus. Accidentally inhaled a few days previously. Localized bronchitis. Lead not corroded.

Fig. 18. Case Fbdy. 574. Amalgam tooth filling, probably composed of silver, tin and mercury; in left stem bronchus 2 weeks. Proximal annular œdema, possibly due in part to tight impaction of the foreign body. Localized bronchitis. Bronchi of the upper lobe and of the other lung were normal. Peroral bronchoscopic dilatation of annular œdema; removal of foreign body. Cure.

Fig. 19. Case Fbdy. 440. Boy, aged 14 years. Lead alloy collar button in left inferior-lobe bronchus 11 years. Proximal, firm, fibrous stricture, covered with granulations. Bronchiectatic cavity, below, lined with granulations, and filled with very foul pus. The button was somewhat corroded. Stricture dilated and foreign body removed by peroral bronchoscopy. Cure.

Fig. 20. Case 243 P. E. Youth of 18 years. Lead alloy collar button in right lung for 10 years. Cicatricial web occluding half of bronchus. At bottom of dilated cavity is the lumen of a firm fibrous stricture. The foreign body was found immediately below this stricture after dilatation. The bronchiectatic cavity below was filled with foul pus. It seems probable that originally the collar button had remained for a long time at the location of the web. Peroral bronchoscopic removal of foreign body. Cure.

NOTE.— Figures 17, 19, and 20 afford opportunity for comparison of the effect of short and prolonged sojourn of lead alloys in the bronchi.

Fig. 21. Case 225 P. E. Boy, aged 5 years. Steel nail in right main bronchus 1 week. Superficial mild bronchitis. Nail coated thinly with film of corrosion. Peroral bronchoscopic removal. Cure.

Fig. 22. Case Fbdy. 410. Boy, aged 11 years. Steel nail in right stem bronchus 9½ years. Chronic purulent bronchitis over entire right lung. Firm fibrous stricture of very small lumen. Granulations and very foul pus filling cavity below stricture. Nail corroded to a cinder-like mass that pulled apart on traction. Peroral bronchoscopic dilatation of stricture and piecemeal removal of foreign body. Cure.

Fig. 23. Case Fbdy. 408. Steel nail in right main bronchus about 3 years. Much corroded nail clasped tightly in a bed of fibrous tissue and granulations. Pus very foul. Peroral bronchoscopic removal of nail. Apparent recovery, followed 2 months later by death from purulent process in lower thorax or upper abdomen. Postmortem unobtainable.

Fig. 24. Case Fbdy. 621. Girl, aged 4 years. Steel nail in left inferior-lobe bronchus 1 month. Bronchitis all over right side due to violent bronchoscopy before admission. Peroral bronchoscopic removal of nail. Cure.

NOTE.— Figures 21, 22, 23, and 24 afford opportunity to contrast the effects of steel nails present in the bronchi for periods varying from 7 days to 9½ years.

Fig. 25. Case Fbdy. 624. Girl, aged 4 years. Pebble in right main bronchus 3 days. Proximal annular œdema, probably from pressure of tightly impacted smooth, round, closely-fitting body. Localized bronchitis. In a previously reported case of a pebble the conditions were precisely the same. Peroral bronchoscopic extraction. Cure.

Fig. 26. Case 266, P. E. Woman, aged 23 years. Brass tag-fastener in right lung 7 years. Chronic bronchitis.

Firm fibrous stricture of stem bronchus, with slit-like lumen, below orifice of middle-lobe bronchus. Very foul pus was coughed through the stricture. A large cavity below the stricture was revealed after dilatation of the stricture. The foreign body was located at the top of the cavity, fixed in fibrous tissue. Foreign body (brass) corroded, but still strong after 7 years' sojourn. Extraction. Cure.

Fig. 27. Case 244 P. E. Woman, aged 48 years. Glass collar button in left lung for 26 years. On passing bronchoscope bronchus was found completely occluded by fibrous tissue. This was excised with biting forceps used through the bronchoscope, until a cavity was reached. Across the neck of the cavity, the collar button was found fixed in fibrous and granulation tissue, as here shown. The cavity contained very foul pus. The collar button was removed by peroral bronchoscopy and patient made a perfect recovery.

Fig. 28. Case 233 P. E. Child, aged 11 years. Brass-headed steel tack in left upper-lobe bronchus 4 days. Slight congestion is present where the tack rests on the spur between the upper-lobe and stem bronchi. Slight areola of inflammation around the buried point of the tack on the inner wall of the main bronchus. Tack not visibly corroded but a black film was wiped away with gauze. Peroral bronchoscopic removal. Cure.

Fig. 29. Case Fbdy. 382. Youth, aged 18 years. Brass-headed steel tack in right bronchus. The head is buried in granulation tissue in the stem bronchus below the orifice of the middle-lobe bronchus; the point is buried in the anterior wall of the main bronchus. Pus foul. Localized bronchitis. The middle-lobe bronchus is relatively normal. Small amount of pus was found in uninvaded lung, probably drawn in shortly before bronchoscopy. Peroral bronchoscopic removal of tack. Cure.

Fig. 30. Case Fbdy. 412. Boy, aged 6 years. Brass-headed steel tack in right bronchus 2½ months. The head is buried in granulation tissue; the point has ulcerated outward through the bronchial wall; but this occurred so slowly that the mediastinum was not affected. Bronchus bronchiectatic below tack; dilatation filled with foul pus. Large area of "drowned lung." Peroral bronchoscopic removal. Cure.

Fig. 31. Case 221 P. E. Woman, aged 52 years. Brass-headed steel tack in left lung 2 years. Granulations have been nipped away, revealing the point of the corroded steel shaft of the tack in an almost closed posterior branch of the inferior-lobe bronchus. The pus was very foul. Peroral bronchoscopic removal. Cure.

NOTE.— Figures 28, 29, 30, and 31 afford an opportunity to contrast the pathologic changes present in 4 different cases, all of the same kind, of a foreign body in the bronchi for periods varying from 4 days to 2 years. The head of these tacks was of umbrella-like shape, the obstruction by which would vary with changes of position.

PLATE II

Fig. 1. Case Fbdy. 411. Girl, aged 17 months. Fishbones in right stem bronchus at orifice of upper-lobe bronchus "many days." Intense localized bronchitis. Peroral bronchoscopic removal. Cure.

Fig. 2. Case 308 P. E. Infant, aged 9 months. Fishbone in right stem bronchus 29 days. Bronchitis localized. Orifice of right upper-lobe bronchus normal. Peroral bronchoscopic removal. Cure.

Fig. 3. Case Fbdy. 386. Woman, aged 25 years. Fishbones in branches of left inferior-lobe bronchus 5 weeks. Bronchitis limited to invaded branches and their orifices. Proximal portion of stem bronchus and the orifice of the upper-lobe bronchus are seen to be normal. Peroral bronchoscopic removal. Cure.

NOTE.— Figures 1, 2, and 3 afford opportunities for noting the effect of fishbones in the bronchi for considerable periods.

Fig. 4. Case Fbdy. 425. Infant, 17 months. Walnut kernel in orifice of right upper-lobe bronchus 3 days. Diffuse tracheobronchitis. Note thickened interorificial spurs. Severe diffuse bronchitis was present in left lung also. Peroral bronchoscopic removal. Cure.

Fig. 5. Case Fbdy. 550. Boy, aged 11 years. Iron casting in right main bronchus 3 days. Localized bronchitis. Left bronchial orifice is normal. Peroral bronchoscopic removal. Cure.

Fig. 6. Case Fbdy. 583. Child, aged 2 years. Half of the glass eye of a "teddy bear" in the right stem bronchus below orifice of upper-lobe bronchus 4 days. Localized bronchitis. The main bronchus above the stem bronchus was normal, as were also all the bronchi on the left side. Peroral bronchoscopic removal. Cure.

Fig. 7. Case Fbdy. 399. Man, aged 44 years. Galvanized steel staple (double-pointed) in a dorsal branch of the right inferior lobe bronchus 15 days. Localized inflammation. Only the concavity of the rounded middle portion of the U-shaped staple is visible. The points are toward us, buried in the mucosa by coughing, and hidden by the annular inflammatory swelling. The orifice of the middle-lobe bronchus (above) and of the upper-lobe bronchus (to the right) are normal. The points of the staple were slowly and carefully freed, brought upward and turned down into the two anterior-branch orifices seen above the invaded bronchus to permit "version" of the staple for safe removal, which was followed by prompt and complete recovery. (See *Journal American Medical Association*, June 5, 1915, p. 1906.)

Fig. 8. Case Fbdy. 409. Man, aged 43 years. Large fence staple, galvanized steel, in left main bronchus 2 years. Localized bronchitis. Acute œdema, due to efforts at bronchoscopic removal before admission, masks the chronic lesions somewhat. Localized bronchitis and perichondritis. The ring of reddish tissue hiding the upward projecting points is fibrous inflammatory tissue, much firmer than the acute œdematous ring in Figure 7. Vessels are visible. There were granulations deeper down below the fibrous ring, where the staple had been lying. The points are deeply embedded by prolonged coughing and ulceration. The staple was removed by version, the points being disembedded, brought upward and turned down into the right bronchus, whose orifice is shown to the right. The limitation of the inflammation after 2 years is remarkable. The carina is not thickened and the right bronchial orifice is normal. Peroral bronchoscopic removal. Cure.

Fig. 9. Case Fbdy. 622. Postmortem bronchoscopic view of a rubber eraser lying in the orifice of the right main bronchus 7 months. The carina is thickened. The thin, greenish, flocculent fluid filled both lungs and the trachea up to the larynx. The view represents conditions after the fluid had been removed sufficiently partially to expose the carina and the rubber. Both lungs were functionally destroyed in 7 months.

Fig. 10. Case Fbdy. 385. Chicken-bone lying loose at the orifice of a bronchiectatic cavity as seen after sponging. Usually foreign bodies of prolonged sojourn are fixed in inflammatory new formation. The bone had been in the lungs about a year. Peroral bronchoscopic rmoval. Cure.

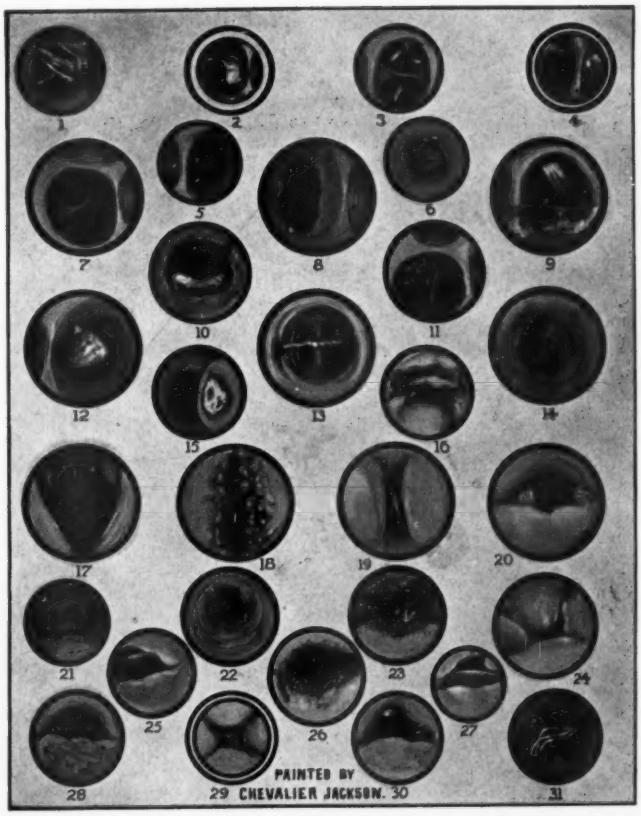
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PLATE II.

Fig. 11. Man, aged 37 years. Perichondritis of the orifice of the middle-lobe bronchus. Unhealed cartilage is indicated by the granulations occupying the orifice of an anterior branch of the inferior-lobe bronchus, in the track of a bullet which passed through the chest 13 months before. This shows the effect of trauma without the continued presence of the foreign body that inflicted it. (Perichondritis is often present in cases of prolonged sojourn such as 9, 14, 22, etc.) Recovery after internal adminstration of small doses of potassium iodide and the use of thromboplastin.

Fig. 12. Case Fbdy. 623. Man, aged 39 years. Beef bone impacted in right main bronchial orifice as seen 23 days after aspiration. Acute localized bronchitis due to rough bronchoscopy before admission. The greenish patch of exudate is due to a wound made in a bronchoscopic attempt to remove the bone before admission. The left bronchial orifice is normal and the carina nearly so. Peroral bronchoscopic removal. Cure.

Fig. 13. Case Fbdy. 310. Woman, aged 39 years. Chicken bone transfixed in trachea. Contrary to the rule, this bone is in the lateral plane. The bone had been in the trachea 6 days, yet the reaction is limited to an areola around the points of fixation. This is in marked contrast to the cases of prolonged sojourn, such as shown in Figures 10 and 14.

Fig. 14. Case Fbdy. 608. Man, aged 20 years. The beef bone had been in the lung 11 years. It is shown beyond a firm fibrous stricture covered with granular, inflammatory, partly epithelialized tissue. Perichondritis. The bone in its crosswise diameter is larger than the stricture but permitted continuous drainage, at both sides, and the lumen of the stricture was not small, which probably accounts for the survival of the patient for so many years in spite of the suppuration. There was a chronic bronchitis throughout right side. Peroral bronchoscopic removal. Cure.

Fig. 15. Case Fbdy. 3676. Boy, aged 14 years. Deciduous molar tooth completely obstructing the orifice of right upper-lobe bronchus, 2 months after accident. The inflammatory mass in which the tooth was embedded is thrown into prominence by strong lateral pressure with the lip of the bronchoscope. Distant bronchi and those of the other side were not inflamed. Peroral bronchoscopic extraction. Cure.

Fig. 16. Case Fbdy. 578. Boy, aged 3½ years. Ring of pearl shell (mollusk) in œsophagus for a period of over one year. Localized chronic œsophagitis, ulceration; swollen folds. Foreign body embedded in a pocket of inflammatory tissue, with granulations at the lateral edges. The shell had whitish incrustations at certain points; but whether or not they occurred during the sojourn in the œsophagus could not be determined. Œsophagoscopic extraction. Cure.

Fig. 17. Case Fbdy. 431. Boy, aged 12 years. Cockle burr in larynx one day. Moderate acute laryngitis; not nearly so severe as one would anticipate from the prickly nature of the foreign body. Extraction. Cure.

Fig. 18. Case Fbdy. 432. Girl, aged 4 years. Lead alloy image of a horse in the larynx more than one month. Larynx swollen almost shut. Granulations, ulceration. Tracheobronchitis was present from the accumulation of secretions due to glottic obstruction and loss of the aid of glottic movement in the bechic cycle. Lead alloy partly covered with a colored varnish, partly not. No apparent corrosion.

Fig. 19. Case Fbdy. 364. Boy, aged 4 years. Brass safety pin in larynx more than 2 months. Larynx swollen nearly shut. Glottic margins eroded. Tracheobronchitis was present from accumulation of secretions that could not be expelled, as in preceding case (Fig. 18). Brass pin blackened by corrosion.

Fig. 20. Case Fbdy. 628. Boy, aged 12 years. Coin (silver half-dollar) in œsophagus 5 days. Slight congestion of œsophagus; no œsophagitis. The silver surface is bright at the sides where it was clasped in the œsophageal folds. The vertical central zone on all surfaces is black with a thick dull corrosion, probably sulphides.

Fig. 21. Case Fbdy. 426. Nursing infant, girl, aged 6 months. Gold "filled" cuff-button partly in trachea and partly in œsophagus. (See Fig. 28.) Button had been swallowed 3 months before and had evidently ulcerated through the party wall into the trachea, the large part of the button being in the œsophagus, the stem between the two parts occupying a fistula through the party wall. Granulations around the fistula. Tracheobronchitis probably from mother's milk leaking through fistula while taking breast. The metal was corroded in patches. Endoscopic removal. Cure.

Fig. 22. Case Fbdy. 630. Girl, aged 12 years. Shoe button (fiber composition with steel eyelet) in left stem bronchus 7 months. Chronic bronchitis limited to left lower-lobe bronchus. Granulations form a bed for the button and obstruct drainage. Some degree of bronchi ectasis was noticeable below the button. Fiber unchanged, steel eyelet corroded. Bronchoscopically removed. Cure.

Fig. 23. Case Fbdy. 558. Boy, aged about 2 years. Cast-iron "jack" in œsophagus about 2 months. Œsophagitis, inflammatory infiltration, granulations. (Compare Fig. 30.) The cast-iron was not corroded in the slightest degree in its 2 months' sojourn.

Fig. 24. Case Fbdy. 434. Woman, aged 57 years. A U-shaped bit of tinned wire from an eggbeater in the œsophagus for 5 weeks. The only inflammatory reaction is a small areola around the location where the two sharp, hook-shaped points have buried themselves in the mucosa. The wire was not corroded except on spots where the tinning was absent. Œsophagoscopic removal. Cure.

Fig. 25. Case Fbdy. 358. Girl, aged 5 years. Copper (or bronze) halfpenny (British) in œsophagus 20 hours. No local reaction; not even congestion. (Compare Fig. 26.) Coin not corroded.

Fig. 26. Case Fbdy. 559. Girl, aged 4½ years. Copper (or bronze) halfpenny (British) in œsophagus 8 months. Granulation, fibrous narrowing, swollen folds. (Compare Fig. 25). The penny was very much corroded.

Fig. 27. Case Fbdy. 354. Boy, aged 2½ years. Gold locket in œsophagus 36 hours. No inflammation or congestion. No corrosion.

Fig. 28. Same case as shown in Figure 21. The large end of the cuff button is here shown as seen in the œsophagus, the stem disappearing in the anterior wall occupies a fistula leading into the trachea. There is a moderate œsophagitis with swollen folds and rough granular mucosa. Peroral endoscopic removal. Cure.

Fig. 29. Case Fbdy. 590. Girl, infant, aged 9 months. Wool from a blanket in œsophagus many days. No œsophagitis. Mucosa not reddened. (Patient a nursling and very anæmic.) Below the wool there was a mild œsophagitis surrounding 3 other foreign bodies; namely, a fragment of a button, a cherry pit, and a mass of cotton wool. All were extracted by œsophagoscopy. Recovery.

Fig. 30. Case 234 P. E. Infant, 11 months old. Cast-iron "jack" in œsophagus 2 weeks. No œsophagitis. Slight congestion. (Compare Fig. 23.) No corrosion of the cast-iron. Œsophagoscopic extraction. Cure.

Fig. 31. Case 93. Boy, aged 3 years. Probang bristles in œsophagus 7 days. Intense œsophagitis due to use of probang before admission. To the right are seen two linear abrasions covered with exudate.

SAFETY PINS

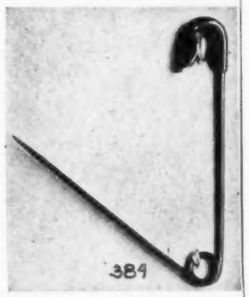
Case Number and Illustration	Age	Foreign Body	Location	Anæsthetic	Tube	Problem	Forceps	Point of Seizure	Result	Time	Route	Remarks
No. 364 Fig. 1	4 yrs.	Safety pin; bent, brass, open	Larynx	None	Laryngoscope	None	Alligator	Keeper end	Extraction Cure	9 sec.	Oral	Larynx swollen nearly shut; glottic margins eroded (Fig. 19, Plate II).
No. 383 Fig. 2	10 mo.	Safety pin (part)	Rt. bronchus, 2 weeks; point up	None	4 mm.	Point up; embedded in left bronchial wall	Side-curved	Near point	Extraction Cure	2 min. 1 sec.	Oral	Diffuse tracheobronchitis; had bronchial symptoms before aspiration of pin.
No. 384  Fig. 3	4 yrs.	Safety pin, open	Larynx, 5 hours; point up	None	Laryngoscope	Open; point up; embedded	Alligator	Near point rotated	Extraction Cure	14 sec.	Oral	Areolar inflammation only.

Fig. 3												
No. 406 Fig. 4	11 mo.	Safety pin, open	Larynx 8 hours; point up	None	Laryngo-scope	Open; point up; embedded	Alligator	Near point rotated	Extraction Cure	26 sec.	Oral	Very slight areola.
No. 566 Fig. 5	2 yrs.	Safety pin, open	Larynx, subglottic, 2 days; point up	None	Laryngo scope	Avoidance of trauma by point	Alligator	Near point rotated	Extraction Cure	10 sec.	Oral	Slight areola; prior to admission treated for meningitis because of aphonia after fall with pin in mouth.
No. 617 Fig. 6	3 yrs.	Safety pin (part)	Left bronchus, 7 months	None	5 mm.	End hooked into orifice p. bronchi l. b.	Side-curved	End	Extraction Cure	2 min. 11 sec.	Oral	Bronchitis; granular mucosa; granulations about lower end of pin.

SAFETY PINS—*Continued*

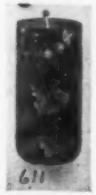
Case Number and Illustration	Age	Foreign Body	Location	Anæsthetic	Tube	Problem	Forceps	Point of Seizure	Result	Time	Route	Remarks
No. 619 Fig. 7	15 yrs.	Safety pin, open	Left lung, lower lobe, point up; 10 months	None	7 mm.	Open pin; point up in lung; end only, in (very small) bronchus	Side-curved	End after bending	Extraction Cure	21 min. 3 sec.	Oral	Granulations fungating; localized reaction; pin had not been in same location 11 months; four bronchoscopies before admission had moved pin.
No. 397 Fig. 8	8 mo.	Safety pin, open	Œsophagus below cricopharyngeus, 2 days; point down	None	Laryngoscope	Preventing keeper from hooking under cricoid	Alligator	Spring end	Extraction Cure	30 sec.	Oral	Traumatic œsophagitis from probang used prior to admission.
No. 415 Fig. 9	10 days	Safety pin and and button (pin open)	Œsophagus below cricopharyngeus; point up; 6 hours	None	Laryngoscope	Point buried, fastening button	Alligator	Near point	Extraction	1 min. (approx.)	Oral	Small areola around buried point.

Fig. 9												
No. 423 Fig. 10	7 mo.	Safety pin, open	Œsophagus; point up; 6 hours	None	Laryngoscope	Open; point up; embedded	Alligator	Near point	Extraction Cure	18 sec.	Oral	Slight congestion.
No. 430 Fig. 11	21 mo.	Safety pin, open	Œsophagus; point up; 6½ hours	None	Laryngoscope	Open pin; point up	Alligator	Near point	Extraction Cure	11 sec.	Oral	Mucosa normal except around buried point.
No. 576 Fig. 12	2 yrs.	Safety pin, open	Œsophagus below cricopharyngeus, 6 hours	None	Laryngoscope ant. com.	Open pin; point up	Alligator	Spring end after version	Extraction Cure	28 sec.	Oral	Mucosa apparently normal; closed by drawing into tube mouth after version.

SAFETY PINS—*Continued*

Case Number and Illustration	Age	Foreign Body	Location	Anæsthetic	Tube	Problem	Forceps	Point of Seizure	Result	Time	Route	Remarks
No. 587 Fig. 13	1 yr.	Safety pin, open	Œsophagus below cricopharyngeus, 7 days	None	Œsophageal speculum	Open pin; point up	Alligator		Extraction Cure	?	Oral	Point buried in mucosa; inflammation around point.
No. 605 Fig. 14	4 mo.	Safety pin, open	Œsophagus at bronchial crossing	None	7 mm.	Open pin; point up	Side-curved	Near point; lip protection.	Extraction Cure	25 sec.	Oral	Œsophageal mucosa apparently normal except slight redness where point lay.
No. 615 Fig. 15	9 mo.	Safety pin, open	Œsophagus at bronchial crossing, 1 week	None	7 mm.	Avoidance of puncture by pushing downward	Straight	Spring end	Extraction Cure	50 sec.	Oral	Mucosa apparently normal.

HARDWARE

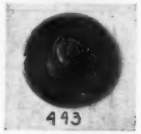
No. 424 Fig. 16	18 yrs.	Brass imitation tooth crown	Rt. stem bronchus close to u. l. b., 10 days	Local	7 mm.	Turning necessary	Straight	Flatwise after turning	Extraction Cure	2 min. 56 sec.	Oral	Localized moderate bronchitis.
No. 430 Fig. 17	10 yrs.	Brass cap	Rt. bronchus, 4 years	None	5 mm.	Finding			Could not be found		Oral	Cap in pleural cavity; removed by thoracotomy.
No. 551 Fig. 18	4 yrs.	Brass cap	Trachea, subglottic	None	5 mm.	Turning	Side-curved	Edge after turning	Extraction Cure	11 min. 56 sec.	Oral	Traumatic tracheitis close to larynx, from motion of foreign body with saw-like edges during 7 days.
No. 572 Fig. 19	9 yrs.	Brass cap	Rt. bronchus, 2 years	None	7 mm.	Hollow; edges buried	Plain and special	Inside and outside	Extraction Cure	17 min. 53 sec.	Oral	Proximal narrowing; granulations; foul pus (Fig. 14, Plate I).
No. 611  Fig. 20.	58 yrs.	Atomizer tip; brass, nickeled	Rt. stem bronchus. 1½ years	Local	9 mm.	Hollow; sharp, ragged edges buried below fibrous stricture, plus granulations	Straight after liberating edges	Side	Extraction Cure	2 min. 55 sec.	Oral	Proximal fibrous stricture covered with exuberant granulations; perichondritis; plating entirely gone; brass corroded (Fig. 13, Plate I).

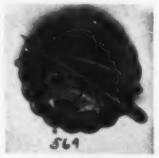
HARDWARE—*Continued*

Case Number and Illustration	Age	Foreign Body	Location	Anæsthetic	Tube	Problem	Forceps	Point of Seizure	Result	Time	Route	Remarks
No. 553 Fig. 21	21 mo.	Brass foot of alarm clock	Left main bronchus, 5 hours	None	4 mm.	Proximal ring of œdematous mucosa	Straight	End	Extraction Cure	1 min. 25 sec.	Oral	Acute diffuse tracheobronchitis; accumulation of mucopus below tightly fitting cork-like body.
No. 367 Fig. 22	11 yrs.	Brass-headed tack	Left bronchus, 4 days	None	7 mm. bronchoscope	Point embedded; mushroom anchor	Side-curved	Shaft near point; rotated	Extraction Cure	62 sec.	Oral	Localized congestion.
No. 382 Fig. 23	18 yrs	Brass-headed tack	Rt. stem bronchus at orifice m. l. b., 7 months	Local	7 mm. bronchoscope	Point embedded in ant. wall u. l. b.	Side-curved	Shaft near point; turned	Extraction Cure	11 min.	Oral	Localized bronchitis right; foul pus; granulations buried tack; bronchiectatic dilation; left side normal except a little pus probably from invaded side (Fig. 29, Plate I).
No. 412 Fig. 24	6 yrs.	Brass-headed tack	Rt. main bronchus, 2½ months	None	5 mm. bronchoscope	Crosswise fixation; point ulcerated out	Side-curved	Point	Extraction Cure	12 min. 4 sec.	Oral	Pus, very foul; granulations; bronchus dilated below tack and filled with foul pus; large area of drowned lung; dull over entire lower lobe. (Fig. 30, Plate I).
No. 408 Fig. 26	24 yrs.	Tack	Rt. main l. b., many years	Local	7 mm.	Stricture; tack invisible around corner	Upper lobe fcps for bringing into view Side-curved for removal after dilatation of stricture		Extraction Cure	16 min.	Oral	Intermittent abscessal discharge after chill, fever, and sweat; localized inflammation.
No. 400 Fig. 25	6 yrs.	Nail	Rt. main and stem bronchi, 3 years(?)	None	5 mm.	End of nail friable from corrosion. masses of corrosion impacted	Side-curved	Point	Extraction; survived 2 months	4 min.	Oral	Granulations and inflammatory tissue held nail; cavity below nail filled with foul pus (Fig. 23, Plate I).

No. 410 Fig. 27 No. 621 Fig. 28	11 yrs.	Nail	Rt. main bronchus, 9½ years	None	7 mm.	Friability from corrosion; stricture	Straight	Gnawed away bit by bit	Extraction Cure	32 min.	Oral	Granulations; stricture; cavity filled with foul pus (Fig. 22, Plate I).
	4 yrs.	Nail	Left inf. l. bronchus, 1 month	None	5 mm.	Transfixion; head anchored in branch orifice	Side-curved	Point after disembedded	Extraction Cure	2 min.	Oral	Bronchitis all neighboring bronchi; right bronchi normal (Fig. 24, Plate I).
No. 399 Fig. 29	44 yrs.	Staple, double-pointed	Post. branch rt. inf. l. b., 15 days	Local	7 mm. 45 cm.	Points upward; buried; proximal œdema	Side-curved Hooks	Curved end after turning	Extraction Cure	1 hr. 24 min.	Oral	Localized inflammation due to puncture of mucosa by points; proximal annular œdema (Fig. 7, Plate II).
No. 409 Fig. 30	43 yrs.	Staple, double-pointed	Left main bronchus, 2 years	Local	9 mm.	Points upward	Side-curved Hooks	Curved end after turning	Extraction Cure	1 hr. 20 min.	Oral	Granulations; fibrous narrowing of lumen proximally; foul pus; no trauma from bronchoscopy done before admission (Fig. 8, Plate II).
No. 550 Fig. 31	11 yrs.	Iron casting	Rt. main bronchus, 3 days	None	6 cm.	Conical end; smooth	Side-curved	Small end	Extraction Cure	6 min. 52 sec.	Oral	Localized bronchitis (Fig. 5, Plate II).

JEWELRY

Case Number and Illustration	Age	Foreign Body	Location	Anæsthetic	Tube	Problem	Forceps	Point of Seizure	Result	Time	Route	Remarks
No. 440 Fig. 32	14 yrs.	Collar-button, lead	Left inf. lobe bronchus, 10 years	None	7 mm.	Stricture; granulations	Side-curved	By post	Extraction Cure	11 min. 2 sec.	Oral	Firmly embedded in granulations and fibrous tissue; bronchiectatic cavity filled with very foul pus below stricture; cavity lined with granulations (Fig. 19, Plate I).
No. 443  Fig. 33	9 mo.	Collar-button, brass	Œsophagus below cricopharyngeus	None	Laryngoscope	Large end presenting	Alligator	Post after version	Extraction Cure	47¾ sec.	Oral	Localized slight œsophagitis; foreign body not corroded.
No. 562 Fig. 34	11 mo.	Bar-pin, open	Left inf. lobe bronchus, 2 weeks	None	4 mm.							Removed postmortem.
No. 554 Fig. 35	2 yrs. 4 mo.	Bar-pin, brass and celluloid	Œsophagus at bronchial crossing, 4 days	None	7 mm.	Open pin; point upward; buried in wall; mass of cotton and food entangled	Side-curved	Hinge after version	Extraction Cure	15 min. 15 sec.	Oral	Local œsophagitis; cotton and food foul; point ulcerated deeply into wall.

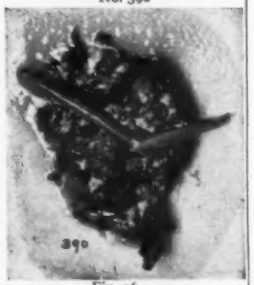
No. 561 Fig. 36	11 mo.	Bar-pin, silver	Laryngopharynx, 24 hours	None	Laryn-goscope	Avoidance of dislodge-ment into deeper passages	Alligator	Pin	Extraction Cure	6 sec.	Oral	Areolar congestion.
No. 441 Fig. 37	4 mo.	Bar-pin, brass	Left bronchus	None	4 mm.	Anchored; open; point up; in small bronchus	Plain after bent probe	End after closing with bent probe	Extraction Cure	4 min. 5 sec.	Oral	Pus streaming in around foreign body; œdema. (Trauma from bron-choscopy before ad-mission.)
No. 564  Fig. 38	21 mo.	Brooch	Œsophagus below cricopharyngeus, 4 days	None	7 mm.	Preventing laceration of point and serrat-ed edges	Rotation	Flatwise permitting rotation	Extraction Cure	35 sec.	Oral	Lacerations beginning to ulcerate; localized œsoph-agitis.

PINS

Case Number and Illustration	Age	Foreign Body	Location	Anæsthetic	Tube	Problem	Forceps	Point of Seizure	Result	Time	Route	Remarks
No. 370 Fig. 39	16 yrs.	Pin	Posterior surface epiglottis overhanging larynx, 2 days	None	Laryngoscope	Extraction without dropping deeper	Alligator	Near point	Extraction Cure	18 sec.	Oral	Areolar inflammation only.
No. 586 Fig. 40	2½ yrs.	Pin	Larynx, 2 months(?)	None	Laryngoscope	Fish-hook shape	Alligator	Near point	Extraction Cure	3 min.	Oral	Septic perichondritis; laryngeal œdema.
No. 618 Fig. 41	8 yrs.	Pin	Base tongue overhanging larynx.	None	Laryngoscope	Extraction without dropping deeper	Alligator	Near point	Extraction Cure	20 sec.	Oral	Slight areolar congestion.
No. 557 Fig. 42	17 yrs.	Needle in trachea	Trachea, 2 hours	None	Laryngoscope	To grasp without losing	Alligator	Near point	Extraction Cure	14 sec.	Oral	Slight congestion only.
No. 394 Fig. 43	18 mo.	Shawl-pin	Left bronchus, 35 days	None	5 mm.	Buried in swollen mucosa	Side-curved	Near point; head pushed downward into branch bronchus	Extraction Cure	14 min.	Oral	Diffuse intense traumatic bronchitis from 2 op., 1 hour each duration, under ether before admission (Fig. 3, Plate I).

No. 565 Fig. 44	No. 569 Fig. 45	8 yrs.	Shawl-pin	Head in left main bronchus, 2 days	None	7 mm.	Point buried in tracheal wall	Side-curved	Near point	Extraction Cure	1 min. 16 sec.	Oral	Hæmorrhage from pin-point puncture (Fig. 5, Plate I).
		63 yrs.	Shawl-pin	Abscess cavity anterior to right stem bronchus, 5 years	Local	Caisson-broncho-scope	Finding pieces of corroded crumbling pin	Malleable ended	As presented	Extraction Cure	37 min. 24 min. 27 min.	Oral	Abscess; minute opening exuding pus; interior of abscess lined with granulations and heavy band of tissue across it (Fig. 7, Plate I).
No. 577 Fig. 46	No. 616 Fig. 47	7 yrs.	Shawl-pin	Left bronchus, 5 months	None	7 mm.	Transfixed	Side-curved	Near point	Extraction Cure	32 min. 13 sec.	Oral	Localized chronic bronchitis; mound-like swelling around buried point (Fig. 4, Plate I).
		7 yrs.	Shawl-pin	Left bronchus; head in u. l. b.	None	7 mm.	None	Side-curved	Near point	Extraction Cure	25 sec.	Oral	Slight congestion; point free; no congestion (Fig. 1, Plate I).
No. 392 Fig. 48	No. 568 Fig. 49	44 yrs.	Shawl-pin	Laryngopharynx, 24 hours	None	Laryngo-scope	None	Alligator	Near point	Extraction Cure	2½ min.	Oral	Sloughing traumatic œsophagitis from attempts prior to admission.
		14 yrs.	Shawl-pin	Hypopharynx, 2 days	None	Laryngo-scope	Transfixion; buried point	Alligator	Near point	Extraction Cure	32½ sec.	Oral	Red areola about 1 cm. diameter around buried point.

Case Number and Illustration	Age	Foreign Body	Location	Anæsthetic	Tube	Problem	Forceps	Point of Seizure	Result	Time	Route	Remarks
No. 395 Fig. 50	46 yrs.	Chicken bone	Œsophagus below cricopharyngeus, 2 days	None	10 mm.	None	Rotation	Flatwise near left point	Extraction Cure	45 sec.	Oral	Slight areolar inflammation localized at 2 points of contact.
No. 407 Fig. 51	46 yrs.	Chicken bone	Œsophagus below cricopharyngeus, 2 days	None	10 mm.	None	Rotation	Flatwise near left point	Extraction Cure	1 min. 10 sec.	Oral	Intense œsophagitis, probably from 2 prolonged esophagoscopies before admission.
No. 555 Fig. 52	43 yrs.	Chicken bone	Œsophagus below cricopharyngeus, 24 hours	None	Laryngoscope	None	Alligator rotation	Flatwise near left point	Extraction Cure	25 sec.	Oral	Slight redness around engaged point.

Fig. 52												
No. 582 Fig. 53	20 yrs.	Chicken bone	Œsophagus at bronchial crossing, 6 days	None	10 mm.	None	Straight and side-curved	Flatwise after turning	Extraction Cure	1 min. (approx.)	Oral	Localized œsophagitis; erosion with red edges at contactual points.
No. 377 Fig. 54	2 yrs.	Chicken bone	Larynx, 10 days	None	Laryngoscope	None	Alligator	Flatwise	Extraction Cure	11 sec.	Oral	Relatively slight local reaction.
No. 385 Fig. 55	12 yrs.	Chicken bone	Right bronchiectatic cavity, 1 year	None	5 mm.	None	Straight	Small end	Extraction Cure	5 min. 3 sec.	Oral	Bone loose in bronchiectatic cavity (Fig. 10, Plate II).
No. 300  Fig. 56	32 yrs.	Chicken bone and meat	Œsophagus below cricopharyngeus, 2 days	None	10 mm.	None	Straight, also mechanical spoon	Fractured part of bone	Extraction Cure	2 min. 3 sec.	Oral	Œsophagitis around puncture of spicule of bone; meat putrid; normal 2 days after removal.

BONES—*Continued*

Case Number and Illustration	Age	Foreign Body	Location	Anæsthetic	Tube	Problem	Forceps	Point of Seizure	Result	Time	Route	Remarks
No. 403 Fig. 57	60 yrs.	Chicken bone	Œsophagus at bronchial crossing, 18 hours	None	10 mm.	Transfixion	Rotation	Near end	Extraction Cure	1 min. 10 sec.	Oral	Mild œsophagitis.
No. 428 Fig. 58	23 yrs.	Chicken bone	Œsophagus below bronchial crossing, 2 days	None	10 mm.	Sharp spicule	Straight	End	Extraction Cure	1 min. (Approx)	Oral	Red areola about 1 cm. diameter.
No. 608 Fig. 59	20 yrs.	Beef bone	Rt. inf. l. b., 11 years	None	7 mm.	Transfixion below firm stricture	Side-curved	Flatwise	Extraction Cure	5 min. 45 sec.	Oral	Firm fibrous stricture; red granular edges; granulations, perichondritis bronchitis (Fig. 14, Plate II).
No. 623 Fig. 60	39 yrs.	Beef bone	Right main bronchus. 23 days	Local	9 mm.	Tight impaction	Straight	Least diameter	Extraction Cure	58 sec.	Oral	Local reaction at points of contact; localized mild inflammation (Fig. 12, Plate II).

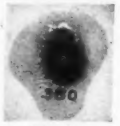
623 Fig. 60												
No. 580 Fig. 61	24 yrs.	Beef bone	Œsophagus below cricopharyngeus, 4 days	None	10 mm.	Shape and size; avoidance of laceration	Rotation alligator	Flatwise	Extraction Cure	15 min. 18 sec.	Oral	Bone putrid; shreds of periosteum and contents of cells foul; local mild œsophagitis; no general symptoms.
No. 614 Fig. 62	68 yrs.	Beef bone	Œsophagus at hiatus, 3 weeks	None	9 mm.	Large, sharp, rough foreign body; tightly impacted	Rotation	Flatwise	Extraction Cure	3 min. 25 sec.	Oral	Linear varicosities; ulceration; plaques of exudate at traumatized points; localized inflammatory area; bone cancellous very foul; no systemic disturbance.
No. 386 Fig. 63	25 yrs.	Fish bone	Left inferior lobe bronchus, 5 weeks	None	7 mm.	None	Side-curved	Flatwise	Extraction Cure	3 min. 30 sec.	Oral	Localized bronchitis; mucopus (Fig. 3, Plate II).

BONES—*Continued*

Case Number and Illustration	Age	Foreign Body	Location	Anæsthetic	Tube	Problem	Forceps	Point of Seizure	Result	Time	Route	Remarks
No. 411 Fig. 64	17 mo.	Fish bone	Right main bronchus	None	5 mm.	None	Straight	As presented	Extraction Cure	4 min.	Oral	Localized bronchitis, severe in degree (Fig. 1, Plate 2).
No. 612 Fig. 65	Adult	Fish bone	Left ventricle overhanging glottis	None	Laryngoscope	None	Alligator	As presented (crosswise)	Extraction Cure	1 min.	Oral	Slight localized congestion
No. 609 Fig. 66	25 yrs.	Fish bone	Œsophagus above hiatus, 8 days	None	10 mm.	Point upward and embedded	Side-curved	Near point	Extraction Cure	1 min. 12 sec.	Oral	Inflammatory swelling around puncture in which point of bone was embedded; stream of blood issuing around embedded point.

SEEDS, NUTS, SHELLS, ETC.

No. 374 Fig. 67	2 yrs.	Peanut kernel	Trachea, 13 days	None	4 mm.	Crosswise position; extreme dyspnœa	Straight	Flatwise after turning	Extraction Cure	18 sec.	Oral	Intense tracheobronchitis simulating diphtheria; antitoxin given.

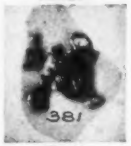
No. 380  Fig. 68	18 mo.	Peanut kernel	Right bronchus, 11 days	None	4 mm.	Fragile	Straight	As presented	Extraction	32 sec.	Oral	Intense tracheobronchitis; pertussis along with other children of family two weeks after leaving hospital; died of "broncho-pneumonia."
No. 402 Fig. 69	3½ yrs.	Peanut kernel	Left stem bronchus, 23 days	None	5 mm.	Fragile	Straight	As presented	Extraction Cure	6 min. 12 sec.		Diffuse severe tracheobronchitis; "drowned lung" over lower lobe showed in radiograph.
No. 439B Fig. 70	6 yrs.	Peanut kernel	Right main bronchus at upper lobe bronchus	None	5 mm.	Fragile	Straight	End; flatwise	Extraction Cure	3 min.	Oral	Intense diffuse bronchitis (Fig. 15, Plate I).
No. 445 Fig. 71	2 yrs.	Peanut kernel	Left main bronchus, 24 days	None	5 mm.	Fragile	Straight	As presented	Extraction Cure	2 min.	Oral	Diffuse bronchitis both sides; pink pus.
No. 573 Fig. 72	5 yrs.	Peanut kernel	Right inferior lobe branches, 3 pieces, 11 days	None	5 mm.	3 fragments in different localities	Straight	As presented	Extraction Cure	9 min. 20 sec.	Oral	Diffuse tracheobronchitis; not severe; muco pus.

SEEDS, NUTS, SHELLS, ETC.—*Continued*

Case Number and Illustration	Age	Foreign Body	Location	Anæsthetic	Tube	Problem	Forceps	Point of Seizure	Result	Time	Route	Remarks
No. 584 Fig. 73	5 yrs.	Peanut kernel	Middle lobe bronchus and branch inferior lobe bronchus, 4 weeks	None	5 mm.	Fragments different location	Straight	As presented	Extraction Cure	17 min.	Oral	Diffuse bronchitis; much pus mixed with some mucus; exudate in patches (Fig. 16, Plate I).
No. 604 Fig. 74	2½ yrs.	Peanut kernel	Right main bronchus at orifice of upper lobe bronchus	None	5 mm.	Proximal annular œdema	Straight	As presented	Extraction Cure	2 min. 19 sec.	Oral	Diffuse tracheobronchitis; rings of trachea obliterated by swellings; pus coming from all branches on right.
No. 444 Fig. 75	8 yrs.	Peanut shell (Greek pistachio)	Left inferior lobe bronchus orifice post branch, 25 days	None	7 mm.	Turning to present edge; fragile	Straight	Flatwise after turning	Extraction Cure	12 min. 32 sec.	Oral	Bronchitis limited to left side; no granulations; pus welled up from drowned lung when foreign body disimpacted.
No. 425 Fig. 76	15 mo.	Walnut kernel	Right upper lobe bronchus, 3 days	None	4 mm.	Around the corner	Side-curved	As presented	Extraction Cure	2 min.	Oral	Severe diffuse bronchitis both lungs; thick mucopus (Fig. 4, Plate II).

No. 570 Fig. 77	70 yrs.	Peachstone	Œsophagus below cricopharyngeus, 6 hours	None	Laryngo-scope	Seizure; tight impaction	Alligator rotation	Presenting end	Extraction Cure	1 min. 5 sec.	Oral	Slight congestion; fruit pulp attached.
No. 595 Fig. 78	28 yrs.	Bayleaf	Larynx, few minutes	None	Kirstein's autoscope	None	Alligator	Flatwise	Extraction Cure		Oral	
No. 429 Fig. 79	2 yrs.	Coffee berry, unroasted	Right stem bronchus, 1 day	None	5 mm.	Tightly jammed from previous bronchoscopy	Straight	Flatwise on end	Extraction Cure	6 min.	Oral	Intense tracheobronchitis probably from prolonged bronchoscopy under general anæsthesia before admission.
No. 431 Fig. 80	2 yrs.	Cockle burr	Larynx, 3 days	None	Laryngo scope	None	Alligator	Across middle	Extraction Cure	14 sec.	Oral	Moderate laryngitis (Fig. 17, Plate II).
No. 368 Fig. 81	3 yrs.	Maize	Right stem bronchus, 2 days	None	5 mm.	Tight impaction	Straight	Flatwise	Extraction Cure	1 min. 7 sec.	Oral	Traumatic bronchitis from two bronchoscopic attempts before admission; no reaction in left bronchi.

SEEDS, NUTS, SHELLS, ETC.—*Continued*

Case Number and Illustration	Age	Foreign Body	Location	Anæsthetic	Tube	Problem	Forceps	Point of Seizure	Result	Time	Route	Remarks
No. 381  Fig. 82	6 yrs.	Maize	Right main bronchus at orifice upper lobe bronchus; 7 days	None	7 mm.	Tight impaction; abundant secretion	Straight	Flatwise	Extraction Cure	2 min.	Oral	Right-sided bronchitis; pus largely admixed with mucus.
No. 404 Fig. 83	3 yrs.	Maize	Trachea, 4 days	None	5 mm.	None	Straight	Flatwise	Extraction Cure	63 sec.	Oral	Diffuse tracheitis, not severe.
No. 414 Fig. 84	3 yrs.	Maize	Trachea, 4 days	None	5 mm.	Crosswise; macerated; dyspnœa	Straight	Flatwise	Extraction Cure	1 min. 4 sec.	Oral	Diffuse tracheitis, not severe.
No. 446 Fig. 85	5 yrs.	Maize (popped corn) hull	Left main bronchus, 5 days	None	5 mm.	Finding			Coughed out through bronchoscope		Oral	Diffuse bronchitis, worse left.
No. 579 Fig. 86	5 yrs.	Maize	Right bronchus, 2 days	None	5 mm.	None	Straight	Flatwise	Extraction Cure	2 min. 54 sec.	Oral	Moderate diffuse tracheobronchitis.
No. 375 Fig. 87	4 yrs.	Watermelon seed	Trachea, 15 days	None	5 mm.	Dyspnœa from sidewise position	Straight	Flatwise after turning	Extraction Cure	19 sec.	Oral	Reaction only a slight localized tracheitis.

No. 376 Fig. 88	1 yr.	Watermelon seed	Left stem bronchus, 6 days; pushed down	None	5 mm.	Jammed tightly from pursuit by previous bronchoscopist; œdema	Straight	Flatwise	Extraction Died	28 sec.	Oral	Septic traumatic bronchitis from 3 bronchoscopic efforts with claw forceps before admission.
No. 379 Fig. 89	2 yrs.	Watermelon seed	Bifurcation, 13 days	None	4 mm.	Somewhat crosswise	Straight	Flatwise after turning	Extraction Cure	34 sec.	Oral	Only slight local inflammation.
No. 417 Fig. 90	21 mo.	Watermelon seed	Right upper lobe bronchus, 11 hours	None	4 mm.	None	Straight	Flatwise	Extraction Cure	1 min. 5 sec.	Oral	Localized bronchitis.
No. 420 Fig. 91	8 mo.	Watermelon seed	Trachea, 16 hours	None	4 mm.	None	Straight	Flatwise	Extraction Cure	1 min. 15 sec.	Oral	Localized tracheitis.
No. 563 Fig. 92	14 mo.	Watermelon seed	Right stem bronchus, 5 days	None	5 mm.	None	Side-curved	Flatwise	Extraction Cure	2 min. 16 sec.	Oral	Localized bronchitis.
No. 371 Fig. 93	8 mo.	Eggshell	Larynx, 3 days	None	Laryngoscope	Fragility	Alligator	Flatwise	Extraction Cure	9 sec.	Oral	Œdema due to parent's finger-nail efforts at removal.
No. 419 Fig. 94	1 yr.	Eggshell	Larynx, 9 days	None	Laryngoscope	Fragility	Alligator	Flatwise	Extraction Cure	12 sec.	Oral	Pus in trachea; probably escape prevented by interference with glottic aid.

COINS AND OTHER DISKS

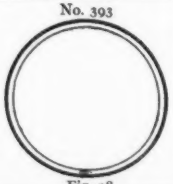
Case Number and Illustration	Age	Foreign Body	Location	Anæsthetic	Tube	Problem	Forceps	Point of Seizure	Result	Time	Route	Remarks
No. 418 Fig. 95	2½ yrs.	Brass disk (Beer check)	Œsophagus below cricopharyngeus	None	7 mm. œsophagoscope	None	Side-curved	Flatwise	Extraction Cure	14 sec.	Oral	Slight congestion at point of lodgement.
No. 373 Fig. 95a	3 yrs.	Coin (quarter)	Œsophagus below cricopharyngeus, 4 days	None	7 mm.	None	Side-curved	Flatwise	Extraction Cure	18 sec.	Oral	Food accumulated; mild œsophagitis.
No. 378 Fig. 96	17 mo.	Coin (penny)	Œsophagus below cricopharyngeus, 7 days	None	Laryngoscope	None	Alligator	Flatwise	Extraction Cure	11 sec.	Oral	Food accumulated; œsophagitis probably from stagnation. T. 101.
No. 388 Fig. 97	3½ yrs.	Coin (nickel)	Œsophagus below cricopharyngeus, 8 days	None	Œsophageal speculum	None	Alligator	Flatwise	Extraction Cure	2 sec.	Oral	Sloughing œsophagitis from œsophagoscopies before admission. Central vertical zone of coin stained yellowish, as in Fig. 103.
No. 393  Fig. 98	2½ yrs.	Coin (quarter)	Œsophagus below cricopharyngeus, 2 days	None	7 mm.	None	Straight	Flatwise	Extraction Cure	1¾ sec.	Oral	Mucosa normal.

Fig. 98												
No. 413 Fig. 99	2½ yrs.	Coin (penny)	Œsophagus, 3 months	None	7 mm.	None	Straight	Flatwise	Extraction Cure	57 sec.		Coin embedded in granulations below constriction; localized œsophagitis.
No. 426 Fig. 100	5 yrs.	Coin (nickel)	Œsophagus below cricopharyngeus, 24 hours	None	7 mm.	None	Straight	Flatwise	Extraction	11½ sec.	Oral	No inflammation; no congestion.
No. 435 Fig. 101	15 mo.	Coin (penny)	Œsophagus below cricopharyngeus, 7 days	None	Laryngoscope	None	Alligator	Flatwise	Extraction Cure	19 sec.	Oral	No inflammation; slight congestion.
No. 438 Fig. 102	3½ yrs.	Coin (nickel)	Œsophagus below cricopharyngeus	None	7 mm.	None	Straight	Flatwise	Extraction Cure	30 sec.	Oral	No inflammation; slight congestion.
No. 439 Fig. 103	3 yrs. 2 mo.	Coin (nickel)	Œsophagus, 5½ hours	None	7 mm.		Straight	Flatwise	Extraction Cure	13 min. 53 sec.	Oral	Central vertical zone of coin stained yellowish.

COINS AND OTHER DISKS—*Continued*

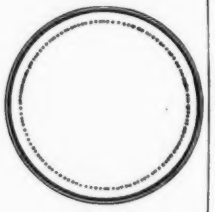
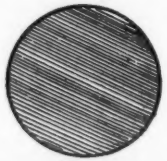
Case Number and Illustration	Age	Foreign Body	Location	Anæsthetic	Tube	Problem	Forceps	Point of Seizure	Result	Time	Route	Remarks
No. 441 Fig. 104	15 mo.	Coin (penny)	Œsophagus below cricopharyngeus, 12 days.	None	7 mm.	None	Straight	Flatwise	Extraction Cure	28 sec.	Oral	Slight localized œsophagitis.
No. 442 Fig. 105	3 yrs.	Coin (nickel)	Œsophagus below cricopharyngeus, 4 days.	None	7 mm.	None	Side-curved	Flatwise	Extraction Cure	½ min. (approx.)	Oral	No inflammation; slight congestion.
No. 556  Fig. 106	13 yrs.	Coin (half-dollar)	Œsophagus below cricopharyngeus, 3 hours	None	7 mm.	None	Straight	Flatwise	Extraction Cure	1 min. 19 sec.	Oral	Mucosa apparently normal.
No. 559  Fig. 107	4½ yrs.	Coin (British halfpenny)	Œsophagus above bronchial crossing	None	7 mm.	None	Side-curved	Flatwise	Extraction Cure	50 sec. (second œsophagoscopy)	Oral	Granulations, fibrous narrowing; swollen folds; coin much corroded (Fig. 26, Plate II).

Fig. 107												
No. 575 Fig. 108	3 yrs.	Coin (nickel)	Œsophagus below cricopharyngeus, 9 days	None	7 mm.	None	Straight	Flatwise	Extraction Cure	2 min. 30 sec.	Oral	Embedded below fold of swollen mucosa; local œsophagitis and erosion, possibly from stagnation of food.
No. 585 Fig. 109	18 mo.	Coin (nickel)	Œsophagus below cricopharyngeus, 15 days	None	7 mm.	Obscured by food, granulations and exudate	Side-curved	Flatwise	Extraction Cure	2 min. 17½ sec.	Oral	Foul food; localized œsophagitis, exudate, beginning granulations.
No. 602 Fig. 110	22 mo.	Coin (penny)	Œsophagus below cricopharyngeus, 5 weeks	None	7 mm.	None	Straight	Flatwise	Extraction Cure	19 sec.	Oral	Foul, sloughing œsophagitis due to œsophagoscopy before admission, masking all appearance of pre-existing lesion if any.
No. 603 Fig. 111	2 yrs.	Coin (penny)	Œsophagus below cricopharyngeus, 4 days	None	7 mm.	None	Side-curved	Flatwise	Extraction Cure	44 sec.	Oral	Slight congestion.
No. 606 Fig. 112	2 yrs. 9 mo.	Coin (nickel)	Œsophagus below cricopharyngeus, 6 days	None	7 mm.	None	Straight	Flatwise	Extraction Cure	23 sec.	Oral	Œsophageal mucosa apparently normal.

COINS AND OTHER DISKS—*Continued*

Case Number and Illustration	Age	Foreign Body	Location	Anæsthetic	Tube	Problem	Forceps	Point of Seizure	Result	Time	Route	Remarks
No. 607 Fig. 113	16 mo.	Coin (penny)	Œsophagus below cricopharyngeus, ? days	None	7 mm.	None	Straight	Flatwise	Extraction Cure	19 sec.	Oral	Mucosa apparently normal.
No. 620 Fig. 114	7 mo.	Coin (penny)	Œsophagus below cricopharyngeus, 5 days	None	7 mm.	None	Side-curved	Flatwise	Extraction Cure	44 sec.	Oral	Mucosa apparently normal; thymic compression of trachea and œsophagus
No. 627 Fig. 115	6 yrs.	Coin (quarter)	Œsophagus below cricopharyngeus, 8 days	None	7 mm.	None	Straight	Flatwise	Extraction Cure	23 sec.	Oral	Œsophagus lacerated and covered with shred-like sloughs from "coin-catcher" used before admission.
No. 628 Fig. 116	12 yrs.	Coin (half-dollar)	Œsophagus below cricopharyngeus	None	7 mm.	None	Straight	Flatwise	Extraction Cure	5 min. 44 sec.	Oral	Mucosa normal; coin corroded and blackened in vertical central zone (Fig. 20, Plate II).

No. 416 Fig. 117	15 mo.	Lead skirt-weight	Œsophagus below cricopharyngeus, 19 hours	None	Esoph. speculum	None	Alligator	Flatwise	Extraction Cure	15¼ sec.	Oral	No œsophagitis; no congestion.
No. 427 Fig. 118	6 yrs.	Poker chip	Œsophagus below cricopharyngeus, 24 hours	None	7 mm.	None	Straight	Flatwise	Extraction Cure	11 sec.	Oral	Mucosa normal.
MEAT												
No. 571 Fig. 119	57 yrs.	Meat (veal)	Above cricopharyngeus, 24 hours	None	Laryngoscope	Pultaceous consistency	Mechanical spoon, alligator form	Scooped out, not seized	Extraction Cure	3 min. 37 sec.	Oral	Goitrous compression stenosis; meat putrid; mucosa locally congested.

BUTTONS

Case Number and Illustration	Age	Foreign Body	Location	Anæsthetic	Tube	Problem	Forceps	Point of Seizure	Result	Time	Route	Remarks
No. 567 Fig. 120	4 yrs.	Button, pearlshell	Œsophagus below cricopharyngeus, 5 days	None	7 mm.	None	Side-curved	Flatwise	Extraction Cure	30 sec.	Oral	Œsophageal mucosa apparently normal at site of button; lower œsophagus lacerated by œsophagoscopy before admission.
No. 630 Fig. 121	12 yrs.	Shoe button	Left inferior lobe bronchus	None	7 mm.	Rounded top presenting below stricture	Side-curved	Edgewise after version	Extraction Cure	8 min. 19 sec.	Oral	Proximal annular swelling; granulations; pus (Fig. 22, Plate II).

MINERALS

No. 624 Fig. 122	4 yrs.	Pebble	Right main bronchus	None	5 mm.	Large, smooth hard, rounded body; annular proximal œdema	Straight	As presented	Extraction Cure	3 min. 15 sec.	Oral	Œdema; slight inflammation, localized (Fig. 25, Plate I).

DENTAL AND SURGICAL OBJECTS

No. 387b Fig. 123	39 yrs.	Dental instrument	Right inferior lobe bronchus, 7 days	Local	7 mm.	Finding in small peripheral bronchus	Straight	Point	Extraction Cure	32 sec.	Oral	Slight local congestion.

Fig. 123												
No. 552 Fig. 124	30 yrs.	Dental instrument	Left upper lobe bronchus, 3 months	Local	9 mm.	Disengaging buried point	Side-curved	Near point	Extraction Cure	1 min. 50 sec.	Oral	Areolar inflammation; patch of purulent exudate (Fig. 11, Plate I).
No. 625 Fig. 125	21 yrs.	Dental instrument	Right middle lobe bronchus, 2 days	Local	9 mm.	Point embedded	Side-curved	Near point	Extraction Cure	2 min. 10 sec.	Oral	Small faint areola at point of puncture (Fig. 6, Plate I).
No. 574 Fig. 126	26 yrs.	Tooth filling amalgam	Left bronchus, 2 weeks	Local	7 mm.	Tight impaction; proximal annular œdema	Side-curved	As presented	Extraction Cure	7 min. 54 sec.	Oral	Proximal annular œdema and tight impaction probably due to shape, specific gravity and air absorption below; localized bronchitis; pus below foreign body (Fig. 18, Plate I).

UTENSILS

Case Number and Illustration	Age	Foreign Body	Location	Anæsthetic	Tube	Problem	Forceps	Point of Seizure	Result	Time	Route	Remarks
No. 434 Fig. 127	57 yrs.	Tinned wire from egg beater	Œsophagus	None	9 mm.	None	Side-curved	Both points after pressing together	Extraction Cure	4 min. 2 sec.	Oral	Inflammatory areola around each embedded point (Fig. 24, Plate II).

TOYS

No. 583 Fig. 128	2 yrs.	Eye of "Teddy Bear" (part)	Right stem bronchus. 4 days	None	5 mm.	Slippery; conoidal	Plain	End	Extraction Cure	5 min. 15 sec.	Oral	Pus coming up around foreign body; localized bronchitis; left bronchi normal (Fig. 6, Plate II).
No. 432 Fig. 129	4 yrs.	Lead alloy "horse"	Larynx, 1 month	None	Laryngo-scope	None	Alligator	Flatwise	Extraction Cure	56 sec.	Oral	Larynx swollen almost shut; granulations; ulceration.

No. 560 Fig. 130	8 yrs.	Wooden whistle; bit rubber	Left main bronchus, 3 days	None	7 mm.	Only central hole visible	Expanding	Periphery of hole	Extraction Cure	8 min.	Oral	Severe inflammation in neighborhood of bit of rubber (Fig. 18, Plate II).
No. 558 Fig. 131	2 yrs. (about)	Jack (castiron)	Œsophagus below cricopharyngeus, 1½ months	None	7 mm.	Buried in granulation tissue	Straight for granulations	Escaped downward	Passed by bowel	15 min.	Passed by rectum	Two weeks in municipal hospital for supposed diphtheria; severe œsophagitis; granulations; foul ulceration; cervical cellulitis; double pneumonia; septic arthritis; condition unimproved after œsophagoscopy; died (Fig. 23, Plate II).
No. 578 Fig. 132	3½ yrs.	Pearl shell ring	Œsophagus at bronchial crossing, 1 year	None	7 mm.	Buried in granulation tissue and swollen folds	Straight	Flatwise	Extraction Cure	52 sec. (2nd esoph)	Oral	Localized chronic œsophagitis; ulceration; granulations; swollen folds; foreign body fixed in pocket of inflammatory tissue (Fig. 16, Plate II).

WOOL AND COTTON

Case Number and Illustration	Age	Foreign Body	Location	Anæsthetic	Tube	Problem	Forceps	Point of Seizure	Result	Time	Route	Remarks
No. 590 Fig. 133	9 mo.	Cotton, fragment of button, (vegetable ivory) cherry pit, wool	Œsophagus (middle third)	None	7 mm.	None	Straight	As presented	Extraction Cure		Oral	Mild localized œsophagitis; no erosion; wool had stale, cheesy odor, not foul; length of sojourn unknown; food had been milk only (Fig. 2), Plate II).

RUBBER

No. 622 Fig. 134	36 yrs.	Rubber eraser	Right bronchus, 7 months									Rubber removed post-mortem; patient moribund when admitted; autopsy; both lungs gangrenous, consolidated and filled with multiple abscesses (Fig. 9, Plate II).
No. 629 Fig. 135	16 mo.	Rubber gasket catsup bottle	Œsophagus (middle third)	None	7 mm.	None	Straight	Flatwise	Extraction Cure	13 sec.	Oral	Œsophagitis.

BLOOD TRANSFUSION[1]

By J. de J. PEMBERTON, M.D., Rochester, Minnesota
From the Mayo Clinic

THE history of the development of the operation for the transfusion of blood is an interesting record of alternate triumph and failure. History is replete with evidence that from early time man's imagination has been stirred by the possibility of restoring health, vigor, and even youth to the aged and infirm by replacing blood of the young and healthy. Stimulated by the wonderful possibilities offered, there has been no dearth of investigators, but insurmountable difficulties prevented the operation from being placed upon a practical basis until recent years. As expressed by an early English writer, "Transfusion is a sort of Will-o'-the-wisp of science, holding out the most brilliant prospects, which never seem to be realized."

In the medical literature on the subject are many references to the report that in an attempt to save the life of Pope Innocent VIII in 1492, he was transfused by a Jewish physician. No description of the method employed is given, but it is recorded that blood from the Pope was first allowed to run into the vein of a youth, whose blood was transferred into the vein of the old man. The lives of three youths were sacrificed in this manner without benefit to the Pope. This is flatly denied in A. H. Matthews' *Life and Times of Rodrigo Borgia*. In speaking of the Pope's death he says: "It is related that, during his last illness, the operation for transfusion of blood was unsuccessfully performed. This, however, is an error, arising from two important facts: first that the idea of this operation could not occur to any one to whom the circulation of the blood was unknown, and second, that the phenomenon of the circulation of the blood was not discovered until the seventeenth century. Raynaldus and Infessura say that a certain Jewish physician undertook to restore the Pope's health. For this purpose he drew all the blood out of three young boys, who immediately died. With their blood he prepared a draught which failed to improve the sick pontiff's condition. The saving virtue of drinking human blood was no new idea."

In 1616, in lectures at the College of Physicians, William Harvey first presented a detailed exposition of his views concerning the circulation of the blood, but it was not until 1628 that he gave his views to the world at large in his celebrated treatise on *Motion of the Heart and Blood*.

Mentions are made of transfusions performed by an Italian physician, Franscesco Folli, in 1654, and by Daniel, of Leipzig, in 1664, but in the writings of most recorders, the names of Richard Lower, of England, and Jean Denys, of France, stand out conspicuously as pioneers, the former as the first to practice blood transfusion experimentally, and the latter the first to perform transfusion in man.

Lower began his experimental work in 1665, transfusing successfully by anastomosing by means of a cannula or pipe the artery of one animal into the vein of another. In 1667, Denys successfully transfused a man, using the blood of a lamb. About the same time, King in England, Immerets in France, and Riva and Manfredi in Italy, practiced transfusion from animal to animal and from animal to man.

It is evident that the new procedure was warmly received by the profession and eagerly put into practice. Deaths resulted and the operation was condemned in France by the Supreme Court interdicting its practice until the Faculté of Paris should give its approval. This was not obtained and for more than a century the practice of blood transfusion was forsaken.

In England, in 1818, the experiments of Blundell revived the interest of the profession. He devised an apparatus consisting of a syringe connected by a two-way stop-cock to a receptacle, and to a tube in turn connected with a cannula for insertion into the vein of the recipient (Fig. 1). He credits Goodridge as

[1]Thesis submitted to the Graduate Faculty of the University of Minnesota in partial fulfillment of the requirements for the degree of Master of Science in Surgery, June, 1918.

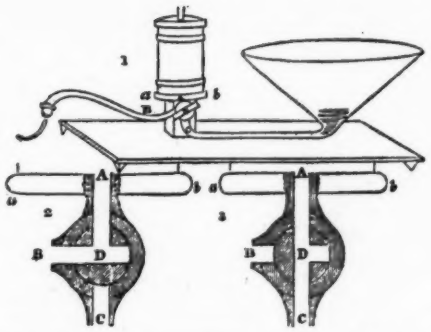


Fig. 1. Transfusion apparatus (taken from Blundell).

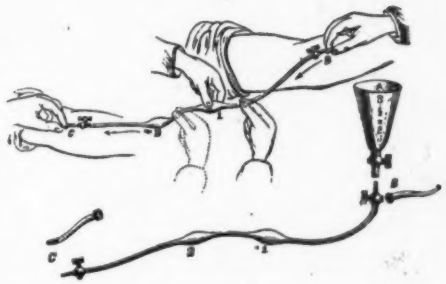


Fig. 2. Transfusion apparatus (taken from Fryer).

having employed the syringe method previous to this. Blundell exposed the femoral artery and vein of a dog and introduced a pipe into each. The blood was allowed to flow from the artery into the cup and was then reinjected into the vein by means of a syringe. This was continued for a period or twenty-four hours, about twelve pints of blood, in all, being reinjected. The dog lived. Later he transfused women suffering from loss of blood due to childbirth, employing human blood, and it is recorded that three out of seven attempts were successful.

In 1835, Bischoff introduced the idea of injecting defibrinated blood, and this method became popular with a large group of workers, among whom were included Prevost, Panum, Dieffenbach and Brown-Sequard. While it was pointed out by Koehler, in 1877, that this form of transfusion was fraught with danger owing to the excess of fibrin ferment injected, and its use was discouraged by Landois, Gesellius, Ponfick, and others, it was used throughout the nineteenth century although with somewhat abated enthusiasm, and in fact was quite extensively employed during the first decade of this century, until it was replaced by the simple methods of today. During this period other methods were devised. Higginson and Aveling used two cannulas attached by tubing to a bulb syringe. Gesellius and Leisrink, in 1872, employed a glass cannula and Landois, in 1875 transfused directly from vein to vein, employing cannulas and tubing. Phosphate of soda (Braxton Hicks) and minute quantities of ammonia (Richardson) were advocated as anticoagulants.

Transfusion became an established procedure the latter part of the nineteenth century and was practiced with a considerable degree of frequency. The success attending the operation was at times brilliant, but reactions described as oppressed breathing, choking, and a train of other more or less serious symptoms met during transfusion, were likely to be attributed to the accidental entrance of air into the vein, although, as early as 1818, Blundell showed experimentally

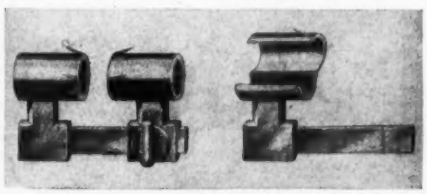


Fig. 3. The complete Soresi instrument; the figure on the right shows how the instrument opens on a hinge (taken from Soresi).

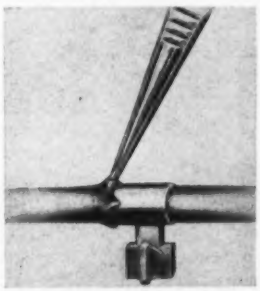


Fig. 4. Showing how the blood-vessel is cuffed over the hooks while blood is still flowing in it; the dotted line shows where the vessel must be cut (taken from Soresi).

Fig. 5. A simple arteriovenous anastomosis (according to Hull).

that the admission into the veins of a small amount of air did not produce any serious effect on the animal. Oré showed that a large quantity of air allowed to enter the veins resulted in death, but minute quantities, as might accidentally get into them, produced no ill effects. This was also observed by Loewenthal in 1871. In the light of our present knowledge, it is certain that many of these reactions were the result of incompatible bloods.

Professor Martin, of Berlin, in 1859, published reports of 57 cases in which transfusion was done in obstetrical practice. There were successful results in 43. Blasius, in 1863, collected all the cases for forty years previous and recorded 116, 56 of which were successful. It is interesting to note that 14 of these in which undefibrinated blood was used, all proved unsuccessful. In the main, clinical indications for transfusion were then recognized similar to those which are observed today. Leisrink in 1872 says: "Transfusion is indicated in all those pathological conditions where the blood, in quantity and quality, is so altered that it is unfit to fulfill its physiological duties." Fryer, who apparently was among the first in this country to employ transfusion, and who used a modified Aveling apparatus, consisting of tube, bulb, and cannulas, recommended its use in asthenic patients before and after necessary surgical measures in order to avert pyæmia, and its allied evils, especially in operations in which the peritoneum is involved (Fig. 2). Dumas and Prevost and Landois pointed out the injurious effects of transfusing the bloods of dissimilar species. Brunton, Hueter and Gesellius, in 1870 to 1873, advocated its use in case of monoxid poisoning, and reported successfully treated cases. Judging from the frequent warning against its use in bleeding cases, except after the bleeding point had been checked, it is evident that its hæmostatic effect was not recognized.

Buchser in 1869 reports a case of a young woman, almost exsanguinated from bleeding from the vagina and bladder following convalescence from typhus, who was transfused with three ounces of blood from her husband by letting the blood run into a warmed receptacle and then injecting it with a syringe into the recipient, which resulted in cessation of the bleeding. Smith, in 1873, reported the case of a child, aged 8 years, with purpura, who had bled from the nose until practically exsanguinated and was then transfused by means of syringe and cannula, defibrinated blood being employed. The result was excellent. No mention was made of the idea of hæmostasis, and it is apparent that the transfusion was employed solely with the view of replacing lost blood. Its value following hæmorrhage was early appreciated. Hicks attributes its want of success in these cases to the postponement of the operation until too late. He recognized that patients who had suddenly lost a large amount of blood were less likely to respond than those whose exsanguination had been protracted.

Autotransfusion by the application of Esmarch bandages to the extremities was advocated by Lesser in 1875.

In 1875, with the introduction of normal saline solution for intravenous therapy, there again followed a period of about thirty years in which there was a very noticeable decline in the enthusiasm for, and employment of, blood transfusion. Because of the technical difficulties met in the successful employment

of the technique in use at that time, and because, also, of the varied results achieved owing, doubtless, to the want of the proper understanding of iso-agglutination and iso-hæmolysis, saline infusion was quickly adopted as a substitute. Prior to this, in 1850, Hodder, in Canada, reported cases of cholera treated successfully by the intravenous injection of fresh cow's milk, and Brinton, lecturer at the Jefferson Medical College in 1878, basing his opinion on the reports of Hodder, Thomas and others, advocated the injection of milk in place of blood transfusion. He concluded that it was feasible and safe, that it was easier than blood transfusion, that it was commonly followed by chills, that the dosage should not be over 8 ounces, and that its practice should not be limited to cases prostrated from the loss of blood, but should be employed in disorders which greatly depreciate the blood, as in cholera, pernicious anæmia, typhoid fever, and others.

While the operation made rapid advances during the nineteenth century, there were two important factors which greatly impeded its progress, that is, the tendency for the rapid clotting of blood during its transference from the donor to the recipient, and the occurrence of hæmolysis resulting from the employment of incompatible bloods. To overcome the first of these, ingenious apparatus for the rapid transference of the blood were devised, defibrinated blood was employed, and attempts were made to delay the coagulation by the addition of chemicals. These were only partially successful. During this time, knowledge of iso-agglutination and iso-hæmolysis was lacking, although its clinical occurrence was seen often and repeatedly described in reports, but the symptoms resulting were attributed to the introduction of air into the veins.

Early after the advent of the present century, rapid progress was made in meeting and overcoming the two chief dangers associated with blood transfusion. Landsteiner and Shattuck independently reported the presence of iso-agglutinins and Landsteiner, in 1901, divided human beings into three groups according to the agglutinating reactions of their bloods. In 1907, Jansky proved that

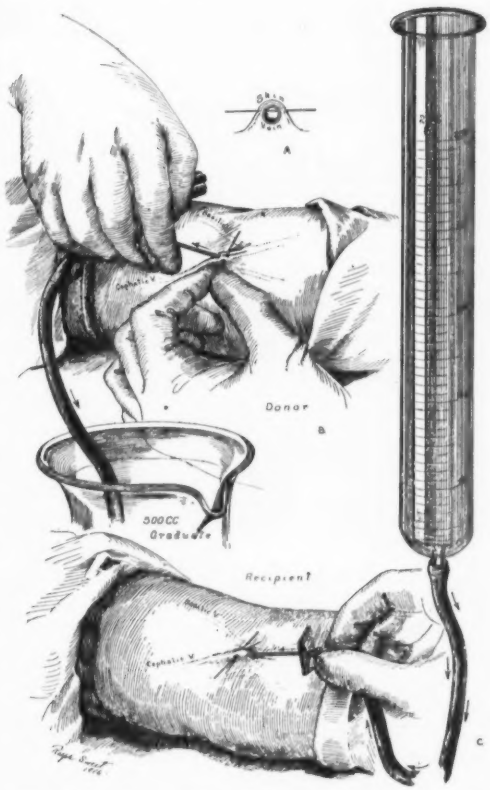


Fig. 6. *A*. Cross-section of vein transfixed in its upper segment to skin by a straight intestinal needle. *B*. Introducing Kaliski cannula into the cephalic vein of the donor. The vein is steadied and prevented from rolling from under the cannula by means of slight traction exerted upon the transfixing needle. *C*. Cannula introduced in vein of recipient.

human beings fall into four groups and this was later confirmed by Moss who made the important observation that hæmolysis of the red blood cells never occurs without their previous agglutination. The tests for the group determination were simplified by Brem, Sanford, and others.

Great strides in blood-vessel surgery were being made at this time, notably by the work of Murphy, in 1897, Doerfler in 1899, Carrel and Guthrie, Crile and others, and this lent impetus to the development of more certain methods of transferring blood.

The first permanent suture of blood-vessels

was made by Eck, a Russian, in 1879, when he established a lateral anastomosis between the portal vein and the inferior vena cava. Murphy, in 1897, successfully anastomosed in men the divided femoral artery by invaginating the proximal into the distal end. Carrel and Guthrie, by the most painstaking details, perfected blood-vessel suture. While Nitze, in 1897, and Payr, in 1900, made successful vessel anastomoses by means of ivory clamps and magnesium rings, respectively, it remained for Crile, the real pioneer in modern blood transfusion, to perfect a method of anastomosing vessels, intima to intima, by the employment of a cleverly devised cannula. He put the method in practice experimentally and in clinical research, reporting 225 experimental and 32 clinical transfusions, at first anastomosing artery to vein, later showing that transfusion could be successfully and readily accomplished by vein to vein anastomosis.

Stimulated by this work, the profession began to realize more clearly than ever the really enormous therapeutic value offered by blood transfusion, and there followed in rapid succession the publication of numerous articles describing "new and simple" methods for transferring blood, and advocating wider fields of application. In 1909, Brewer and Leggett, after successfully experimenting on 31 animals, advocated transfusion by the interpolation between the artery and vein of a paraffin-coated glass tube. In the same year, Frank and Baehr, transfused by means of a vascular bridge or link made of a dog's carotid and preserved in 2 per cent formalin, to connect the artery to the vein. The Lespinasse and other modifications followed.

Ingenious modifications of the Crile cannula were devised by Buerger, Soresi, Janeway, McGrath, and others (Figs. 3 and 4).

Hull has described a method of arteriovenous anastomosis which, for its simplicity and sureness of accomplishment, should commend itself to those who may have occasion to perform an emergency transfusion, when anticoagulants and the ordinary apparatus are not to be obtained. The donor's radial artery is exposed and divided, and compression is made on its proximal end to prevent flowing. The recipient's vein is exposed for a distance of one inch and a small slit is made in it, large enough to admit the artery, which is carried into it by means of a needle and suture (Fig. 5). Mann has reported its successful application in experimenting with the method in the laboratory.

The use of any of these methods necessitated the sacrifice by the donor of either an artery or a vein, and with every donation he subjected himself to considerable risk. In addition it was impossible accurately to determine the amount of blood transfused, estimates being based upon blood pressure and hæmoglobin readings. Curtis and David overcame the last objection by employing a receptacle for the blood and then re-injecting. Their apparatus consisted of a glass bulb, paraffin coated, with two cannula tips at one end and, attached to the other end by means of rubber tubing, a syringe. This idea was modified by Kimpton and Brown, Percy, and Satterlee and Hooker, and it resulted in the perfection of a method of transfusion which under favorable circumstances; is ideal. The one essential objection lies in the difficulty in the coating of the tube and connections with a uniform layer of paraffin. Any error in this means failure.

In 1892, von Ziemssen devised and employed successfully a method of transfusion by means of syringes and cannulas: "By rapid work he was able to draw 20 cubic centimeters of blood from a subcutaneous venous puncture, disconnect the syringe, and empty it through a needle similarly placed in the recipient's vein before coagulation took place. By filling the syringes one after another he transfused 280 cubic centimeters at one time." The method did not receive the attention it deserved and was soon forgotten. In 1913, Lindeman improved the technique by adding a larger number of syringes which were kept constantly washed by an assistant, and by devising a special nest of three cannulas, the outer one rounded on its end to prevent injury to the intima. Its application was certain and, with a specially trained operator and assistants, the method was nearly perfect. By the utilization of the principle of a two-way stop-cock, modifications were devised by Freund, Unger, and Kush.

In 1914, Hartwell wrote: "The attainment of the ideal seems to lie in the development of a method by which coagulation and other alterations of the blood are prevented during the time required to draw sufficient blood (1000 cubic centimeters) into a receptacle connected by subcutaneous venous puncture with the donor and to empty it again through a similar puncture in the recipient—these two principles, if desirable, being in separate rooms." Except in the hands of those skilled in the application of a special technique, and under the most favorable circumstances, none of the methods up to this time fulfilled all of these requirements. Excluding those methods in which the technique required the employment of a paraffin-coated receptacle, the successful application of all others was dependent upon the rapid transference of blood from donor to recipient in less than the normal coagulation time. In devising a technique to fulfil the requirements of the ideal, it was natural then, that means should be sought to retard the coagulation time without altering the normal properties of the blood. Various means were employed, that is, by the dilution of the blood with normal saline, by isotonic glucose and by the addition of chemicals, namely, herudin and sodium citrate.

In 1914 and 1915 Hustin, Agote, Weil, Lewisohn, Rueck, and others, working independently of one another, published articles recording experiments and clinical application of transfusions performed with citrated blood. Hustin's article appeared August 6, 1914. He mixed the blood with equal parts of isotonic (5 per cent) glucose solution to which was added 20 cubic centimeters of sodium citrate for every 200 cubic centimeters of blood-glucose mixture. He claimed that citrate of soda impaired the oxygenating property of the blood and the addition of glucose was necessary to overcome this. He reported experiments and one clinical application in man. The first transfusion performed in man by blood rendered incoagulable by the addition of sodium citrate alone was performed by Prof. L. Agote of Buenos Aires on November 14, 1914. He employed 1 grain of neutral sodium citrate in 25 per cent solution for every 100 cubic centimeters of blood. Weil observed that citrated blood augmented the coagulative properties of the recipient's blood. From the work of Lewisohn in determining the proper dosage of sodium citrate which can be used with safety, there has developed a method which "unites four advantages in surgery of extreme importance—facility, rapidity, efficacy and security," and which fulfills in every detail the requirements of the ideal.

CLINICAL APPLICATION

This report of a series of 1036 blood transfusions, summarizing the results and recording the general indications and dangers, is submitted because of the belief that the most accurate test of the value of any therapeutic procedure developed from experimental study, lies in its repeated clinical application.

The 1036 transfusions were performed on 429 patients between January 1, 1915, and January 1, 1918, in the Mayo clinic. Five were done by means of the paraffin-lined cylinder, 30 by a modified cannula-syringe technique, and the others, 1001, by the citrate method.

INDICATIONS FOR TRANSFUSION

With the development of simpler methods of technique, and with the introduction of accurate blood tests, blood transfusion has lost the dangers which once attended its use, until today it is a safe and proved therapeutic measure, rather than merely a means of last resort. If blood transfusion is looked upon as a homologous transplantation of living tissue, as suggested by Hartwell, the indications may be epitomized as being those which indicate the necessity of restoring the lost or impaired body tissue (blood) by a homologous transplant. Definite effects of transfused blood are: (1) restoration of the bulk of the circulating fluid, (2) provision of oxygen and assimilable pabulum for tissues, (3) increase of the coagulability, (4) stimulation of the hematopoietic organs, and (5) increase of resistance to infection by its antitoxic and bactericidal properties.

In this series, the cases may be grouped according to indications for transfusion as follows:

1. Primary (pernicious) anæmia, 657 transfusions in 185 cases.

2. Secondary anæmia, 243 transfusions in 149 cases.

Chronic infection	24 cases
Malignancy	44 cases
Chronic hæmorrhages	43 cases
Acute hæmorrhages	7 cases
Hæmolytic jaundice	4 cases
Splenic anæmia	10 cases
Actinomycosis	2 cases
Causes unknown	15 cases

3. Bleeding, 81 transfusions in 59 cases.

4. Acute toxic and septic conditions, 34 transfusions in 25 cases.

5. Leukæmias, 20 transfusions in 10 cases.

6. Shock, 1 transfusion in 1 case.

A detailed analysis will not be made of the cases included in this report, but for completeness a general summary and discussion of the results obtained will be given under each group of cases.

Group 1. Pernicious anæmia. Basing his opinion, presumably, upon the fact that destruction of the patient's own blood is more or less continuous in this group of cases, Soresi classified pernicious anæmia with malignancy, as being the two diseases in which the operation for blood transfusion was absolutely contra-indicated. While the percentage of occurrence of the milder reactions following transfusion is decidedly greater in this class of cases, due probably to the slight hæmolytic action of the blood of the patient upon the blood transfused, definite beneficial effects are seen in a very large percentage of cases. The result varies in different patients, and also in the same patient, following separate transfusions. Whether this variation is the result of the difference in the stimulating properties of the bloods of the different donors, or to a difference of degree in the active hæmolysis of the patient, depending upon the stage of the disease, is a matter of conjecture. The observation based upon the results in this series would tend to support the latter theory. One patient who had been transfused previously, with definite improvement, returned after several months, in a very grave condition—lethargy, temperature 102-3°, hæmoglobin below 20 and red blood cells below one million. He was given 500 cubic centimeters of blood from a suitable donor. A definite reaction of chill, fever, increased drowsiness and hæmoglobinuria followed, and later, herpes on the lip. The patient received no improvement from the transfusion.

A series of transfusions ranging from 1 to 30, was practiced in the cases in this group; some were performed preceding and following splenectomy, but the vast proportion were in non-operated cases. The results were equally good in the different groups. One case of unusual interest is herein reported:

A male, aged 36 years, was admitted for examination February 10, 1915, with a history of good health until about one year previous to admission, when weakness, shortness of breath and increasing pallor gradually developed. From the history, examination and blood findings, a diagnosis of pernicious anæmia was made. At this time his hæmoglobin was 20 per cent, red blood cells 1,730,000, with the presence of normoblasts and megaloblasts. Splenectomy was performed March 10, 1915, and April 7, 1915, before his dismissal, the hæmoglobin was 70 and the red cells 3,640,000. Following acute tonsillitis in the fall he began to run down, and on December 1, 1915, he returned with hæmoglobin 20, and red blood cells 1,190,000. From then until May, 1918, he had thirty-five transfusions of 500 to 750 cubic centimeters each. His response to the transfusions has been remarkable. Ordinarily two to four transfusions at weekly intervals are required to effect a definite remission in the course of the disease. His condition now is apparently as good as it was two years previously. It is of special interest to note that the blood of the patient belongs to Group 1 and while there have been transfused into him blood of all four groups, without any evidence of hæmolysis, he has retained his original grouping.

The conclusions of Archibald, who made an extensive study of a part of the cases in this series, hold good for the series in its entirety. In effect his conclusions were that the greater number of the patients, except those who have reached the very last stages of the disease, will receive immediate benefit from the transfusion of blood. Many also who are in extremis, and who are not benefited by medical treatment alone, will show great improvement by a series of blood transfusions.

Group 2. Secondary anæmias. Except in the seven instances in which the anæmia was due to acute hæmorrhage, the majority of the patients in this group were transfused preliminary to operation, with the idea of improving their general condition and thereby

increasing their resistance to infection. In cases of acute, frank and concealed hæmorrhages, the enormous value of replacing the lost bulk of fluid by blood in connection with efficient surgical means of checking further loss, is well recognized. As pointed out by Hicks in 1869, "the want of success in transfusion lies in the postponement of the operation until too late a period." The normal quantity of blood is estimated to be one-twelfth to one-fourteenth of the body weight, and clinically, the rapid loss of one-half of this amount proves fatal. Various "rules o' thumb" have been offered, based upon the blood pressure readings and hæmatologic estimates, indicating when to transfuse and when it is safe to wait. Dorrance considers it imperative to transfuse when the count falls to 1,000,000 red blood cells and 20 per cent hæmoglobin, or below, and optional when the red cells are 1,500,000 and hæmoglobin 25 per cent. DePage studied wounded soldiers and found that when the red cells fall below 4,500,000 in three hours, 4,000,000 in eight hours, or 3,500,000 in the first twelve hours, the patient will probably die unless transfused. Others have considered the blood pressure readings as the most reliable indicator, pointing out that systolic pressure below 80 mm.Hg. meant danger. Hicks relied solely upon clinical symptoms, especially "the obstinate jactitations and resistance to comply with our wishes in regard to treatment, coupled with the persistent indistinctness of pulse." Robertson warns us against using ordinary resuscitative measures before resorting to transfusion. Our clinical observations bear out his belief that permanent degenerative changes occur in the organism when the exsanguinated condition persists for more than a few hours. We advise transfusion when in doubt. From experiments, Rous and Wilson demonstrated that the amount of hæmoglobin retained in the severest hæmorrhage is above the point necessary to sustain life. Unless the blood withdrawal is too rapid, the organism replaces this bulk by substituting plasma which the body retains in reserve, and thus maintains blood pressure. In animals bled, the investigators were able to raise and maintain the blood pressure reading by the injection of either horse serum or gum acacia (7 per cent). The effect of normal saline solution was only transient, as this quickly leaves the vessels for tissues and urine. David and Curtis showed that dogs bled under similar conditions, until there was cessation of flow at the carotid, could be resuscitated either by injection of physiologic serum or by transfusion. However, in the eighteen hours following this experiment, 77 per cent of the dogs treated with serum died, and only 6 per cent of the animals transfused, succumbed. In all but two cases in this series of acute hæmorrhage, the transfusion was life-saving or greatly beneficial. In the two unsuccessful cases, the patients were temporarily restored, but later, died due to the continuation of the bleeding.

The results of transfusion on the weak, starved, and anæmic patient, as a supportive measure preliminary to operation, are eminently gratifying, as is evidenced both by the increased ability to withstand the operation and by the rapid postoperative convalescence. In the anæmic cases in which the patients are to be submitted to abdominal operation, transfusion is especially indicated. It may be safely asserted that in practically all operations in which the gastro-intestinal tract is opened, there is more or less soiling of the peritoneum which potentially spells peritonitis. It is the normal resistive elements of the organism which prevent this eventuality or limit it to a small area. In those cases in which the resistance of the body has been impaired by chronic bleeding, malignancy, and chronic infection, this complication is most frequently seen. The value, then, of transfusion as a preliminary measure is illimitable.

Group 3. Bleeding. The general oozing which follows certain operations, especially in intensely jaundiced patients, has always been a source of grave concern to the operator, who, in most instances, has been without efficient means of checking it. The results of blood transfusion in these cases have been strikingly good; usually the hæmorrhage ceases almost immediately, and the patient's improvement is quickly obvious. In certain cases, usually of the malignant type in which

the biliary obstruction has not been relieved by the operation, the hæmostatic value of the transfusion rapidly decreases, after 48 to 72 hours, and the patient may start bleeding again. Also, in the oozing occurring after operations on the stomach and intestines, transfusion alone will often be followed by complete and permanent cessation of bleeding, and the rapid convalescence of the patient. The bleeding in ulcers of the stomach and duodenum is usually due to an erosion of one of the larger vessels and transfusion should always be considered preliminary to, or in association with, a laparotomy for the excision of the ulcer. For the postoperative bleeding in patients suffering from blood dyscrasia, transfusion is an effective hæmostasis, but probably has no effect upon the ultimate course of the disease. It is of interest that, clinically, the use of an anti-coagulant in the transfused blood not only does not retard the coagulability of the recipient, but possesses an equal power of hæmostasis with the undiluted blood administered by the syringe-cannula method. Experimentally, this observation was borne out in a series of 41 transfusions by the citrate method in which the coagulation time of the recipient was tested by means of a Boggs' coagulometer and by Lee's test-tube method, just prior to, and immediately following, the transfusion. In 25 instances (58 per cent), the coagulation times was lowered from 1 to 6 minutes; in 6 (14 per cent) it was not affected, and in 12 (28 per cent) it was increased from 1 to 3 minutes. The coagulation time of a hæmophiliac, not included in this series of tests, was taken before transfusion, and recorded as 23 minutes. Five minutes after the transfusion of 500 cubic centimeters of citrated blood, the coagulation time was 3 minutes, 12 hours later it was 8 minutes, and on the fourth day after the transfusion, the coagulation had returned to 20.

Group 4. Acute toxic and septic conditions. The cases included in this group were for the most part infections following abdominal operation, and while the results are not encouraging, largely because of the fact that the patients were hopelessly ill before transfusion was employed, we believe that if given shortly after or, in some instances, before, the operation, blood transfusion offers a reasonable means of combating infection.

Group 5. Leukæmias. As a temporary supportive measure for the correction of the anæmia, the results in the ten cases in this series justify the employment of transfusion.

Group 6. Shock. In this series the diagnosis of surgical shock has been made in the cases of postoperative patients in whom there is no tenable etiologic factor for the production of the chain of symptoms usually attributed to this condition. The clinical diagnosis is often disproved upon re-opening the abdomen or at necropsy, by the presence of "concealed" hæmorrhage, or fat embolism. In the one case in this series, transfusion was without beneficial effect.

METHOD OF TRANSFUSION

Since December, 1915, we have employed the citrate method exclusively, and it has been used in this series of cases in 1001 instances. According to Howell, the rôle of calcium in the phenomenon of coagulation is to activate prothrombin into the formation of thrombin (fibrin ferment) which in turn activates fibrinogen into fibrin. By the addition of citrate of soda, coagulation is prevented by the chemical immoblization or stabilization of the calcium without forming precipitate. Excessive intravenous injection of citrate of soda deprives the blood and tissues of calcium, and the symptoms of convulsions, tonic and clonic, tetany, paralysis and dyspnœa, are the results of the decalcification of the nervous system. To combat this, Hedon would administer calcium in the proportion of one atom to three molecules of the trisodic citrate. Lewisohn, experimenting with a 10 per cent solution, found the toxic dose equivalent to 0.3 grams per kilo, and later Carter showed that the more concentrated the dosage, the smaller the lethal dose. He found the lethal dose with a 2 per cent solution to be 0.835 to 1.24 grams per kilo. Early in this series it was observed that there was a tendency for the milder reactions to occur in cycles, which corresponded in a striking manner with the preparation of fresh citrate solution. It was observed that citrate in

solution rapidly deteriorates, and the importance of employing freshly prepared solution was thus emphasized. From the recognition of the fact that the coagulative properties of different bloods vary in different persons, as evidenced by the occasional coagulation of blood withdrawn from the donor in a 2 per cent citrate solution, we have substituted a 0.24 per cent citrate solution.

TECHNIQUE

The arm of the donor is prepared in the usual manner. A tourniquet is lightly applied above the elbow and the median basilic or the median cephalic vein is either punctured with a large-sized needle or exposed by a small incision, and a cannula introduced. By a simple, yet very ingenious little trick, advised by Watson, we have been aided greatly in introducing a large-sized Kaliski (gauge 11) needle into the lumen of the vein. By means of a small, straight intestinal needle, inserted transversely, the vein is transfixed to the skin, the needle passing through its upper segment. With the end of this transfixing neelde as a handle, the vein is steadied and the cannula needle, directed parallel with the line of the vein, can be readily pushed beneath the level of the transfixing needle into the lumen of the vein (Fig. 6). The blood is received in a sterile graduated glass jar containing 30 cubic centimeters of a 2 per cent sterile solution of sodium citrate at the bottom. While the blood is running, it is well mixed with the citrate solution by means of a glass rod. The flow of the blood should be in a steady continuous stream, and when there occurs slowing of the stream, as is often observed with a sudden drop in venous pressure, due either to syncope or the too snugly applied tourniquet, the needle should be immediately withdrawn and a clean one inserted. If the blood is allowed to flow in an impeded stream, there will be clotting of the whole or part of the blood collected because of the incipient coagulative changes which have taken place in transit from the vessel to the citrate solution. After the blood has reached the 250 cubic centimeter mark another 30 cubic centimeters of the citrate solution is added and the blood is permitted to flow until there are 500 cubic centimeters of the mixture. If more blood is desired, a sufficient amount of citrate solution is added to maintain this ratio of 0.24 per cent. The blood may be carried to the recipient's room or the recipient may be brought into the operating room. The needle is then introduced into the recipient's vein, after the manner above described, and attached by rubber tubing to a glass irrigating flask, the tubing and the bottom of the flask having been previously filled with saline solution. The citrated blood is then transferred into the flask and permitted to flow into the vein of the recipient. It is advisable to have the blood run in slowly in order to guard against suddenly overloading the right side of the heart, and in order to watch for any untoward effects upon the patient. A marked slowing of the pulse, syncopal attacks, dyspnœa, cyanosis, a sensation of cardiac oppression or excruciating pain throughout the body, especially localized in the small of the back, should be interpreted as danger signals, and if these persist after temporary stopping of the flow, it is advisable to conclude the operation at once, and another donor should be secured.

The amount of blood to be transfused should be dependent upon several factors, namely, the age of the patient, the presence of associated physical impairments, such as cardiac lesions, arteriosclerosis, etc., and the pathologic condition for which the transfusion is indicated. Unless for the purpose of replacing a large bulk of blood lost from an acute hæmorrhage, the impression received from the study of this series of cases would indicate that better results are to be expected from the use of a relatively small quantity, 500 to 750 cubic centimeters, repeated in from five to seven days, rather than from a single transfusion of a larger amount. While the evidence is most conclusive that the transfused blood lives for a time at least as a transplant, yet a greater value in many of the anæmic conditions lies in its stimulating effect on the blood-forming organs of the recipient, as is evidenced by the secondary rise in the hæmoglobin and blood picture, which occurs four or five days after the transfusion.

DONORS

In the selection of a suitable donor, a young healthy, robust individual is desired. Our results tend to corroborate the observations of Peterson that the value of the transfusion is largely dependent upon the individual donor. One donor's blood may exhibit remarkable powers of hæmostasis, that of another may induce unusual hæmatopoietic stimulation, and that of another, owing to the presence of some antibody, may exert real antitoxic effect. The blood of every donor should be tested for syphilis and as to its compatibility in reference to agglutination and hæmolysis. The seriousness of transmitting syphilis or other diseases, especially to those patients in whom there is no urgency for the transfusion, cannot be overestimated. As our ability for detecting syphilis, by examination and Wassermann test, is within limits, and as there is a possibility of the infection of the donor subsequent to his examination, the chances of transferring syphilis, while admittedly small, should always be considered, and unless the transfusion is performed in emergency, this possibility should always be explained to the patient. Two instances of syphilis transmission are reported in the literature. In our series, syphilis was transmitted by transfusion in one instance. This patient had been receiving a series of transfusions; the blood of the donor, in each instance, was Wassermann negative. One man who had served as a donor about twelve days prior to the development of the skin eruption was suspected as the infecting donor, but these suspicions could not be definitely confirmed.

Since July, 1916, the blood of the prospective donors has been tested according to the Moss agglutination test, as modified by Brem. In instances of the newborn, when it is necessary to transfuse in order to check hæmorrhage, Cherry and Langrock have showed, in a series of 34 tests, that the mother is always a suitable donor. However, it should be emphasized that after the first few weeks of life the child develops an independent group of its own which is not necessarily the same as that of the mother, and accordingly tests should always be made preliminary to transfusion. In an emergency, such as that following an acute hæmorrhage, when the life of the patient is dependent upon an immediate transfusion, it is justifiable to use a donor without a preliminary test. In such instances the operator should allow the first 200 cubic centimeters of blood to run in slowly. If the patient shows symptoms of hæmolysis, the operation should be concluded or another donor secured. In this series we used donors without preliminary test in eight emergency transfusions and in none of the patients was there any evidence of hæmolysis. These results, we believe, were due to good fortune.

In 1913, Ottenberg and Kaliski explained that in the instance in which the serum of the donor is agglutinative to the cells of the patient, the plasma of the donor, on transfusion, will be diluted by the excess of the patient's plasma and will meet with a large excess of agglutinable cells. In practice they had four such transfusions with no unfavorable results. When it has been feasible we have always made it a point to use a donor in the same group as that of the recipient, but in a great number of instances, as in emergencies, and in cases in which a relative or volunteer donor is obtainable whose blood is not in the same group with that of the recipient, we have used donors whose cells are not agglutinable by the serum of the patient. In Group 4 there is a large percentage (43 per cent) of persons whose blood is suitable for transfusion with the blood of all the groups, and this point has been utilized in our emergency transfusions. Formerly, in cases of utmost urgency we were forced to take a large chance by using an untested donor, but now there is always on call a list of prospective donors in Group 4 whose blood, we have absolute confidence, will be suitable with that of any patient. In the entire series there have been no untoward effects upon the donor from the loss of 500 to 750 cubic centimeters. On the other hand, the loss of blood in the majority of donors has been followed by a temporary gain in weight. Many of these donors continue their normal duties immediately upon the conclusion of the transfusion. We have used especially robust persons as donors as often as 8 times within 12 months.

There are three well recognized accidents associated with and complicating blood transfusions, namely, acute dilatation of the heart, embolism from the introduction of air or clotted blood, and hæmolysis. The first two accidents are absolutely preventable by the exercise of due caution as to the technique, the rapidity with which the blood is permitted to flow, and the limiting of the quantity of blood in cases of suspected cardiac and circulatory impairment. The third danger, due to the incompatibility of the blood of the donor and the blood of the recipient, is controllable by accurate blood tests. By the term "hæmolysis" we mean the destruction of the red blood cells with the liberation of the hæmoglobin and clinically we detect this by the finding of hæmoglobinuria, increased urobilin in the urine and phagocytosis of red cells. The gravity of the danger depends upon the degree of destruction.

REACTIONS

In 219 transfusions (21 per cent) of the series, there occurred from 15 minutes to one hour later, a slight reaction of chill and fever, a temperature of 100 to 105°, with or without malaise, headache, nausea and vomiting and diarrhœa, and followed, in a small percentage of cases, on the third day after the transfusion, by an eruption of herpes. In another 15 per cent of transfusions there occurred a rise of temperature to 100° or above, not associated with chill and nausea. These were, in every instance, of a transitory nature, the temperature returning to normal in from 12 to 36 hours, and in only two instances was it at all probable that the good of the transfusion was vitiated by this complication.

The nature of such reactions is unknown. Various theories have been suggested, for example: (1) the introduction of a foreign protein, (2) the introduction of a citrate solution, (3) incipient coagulative changes in the transfused blood, (4) slight degree of hæmolytic changes occurring after transfusion not sufficient to be evidenced by clinical test, and (5) incompatibility of the white corpuscles of the donor and recipient. All may be factors, but in this series there was a striking relationship between the pathologic condition for which the transfusion was indicated, and the occurrence of these milder reactions. A decidedly higher disproportion in the percentage was seen in those cases, such as pernicious anæmia and advanced malignancy, in which there were active hæmolytic changes. In some of these, the intravenous introduction of normal saline alone was followed by similar reactions.

In 1915, Bernheim collected data of 800 transfusions performed by 12 different operators, and reported the occurrence of hæmolysis in 15 cases, with four deaths. In 12 instances in this series there were group reactions. The blood of three of these patients had been tested by the old macroscopic test, and the others had been grouped by the method of Brem. In every case in which the blood had been grouped by the microscopic test, we were able later to locate an error in the testing. Most of these were due to a clerical error in recording the group of the donor or the recipient. In one patient, supposedly in Group 2, attempts were made on two different occasions to inject blood from a donor in Group 2, and both times we were forced to stop because of the occurrence on the table of a severe reaction. Later, this patient's record was reviewed, and he was found to be in Group 3 instead of Group 2. Retesting proved this, and subsequent transfusions with Group 3 donors were unattended by any reaction. These reactions are most typical. They occur early after the introduction of 50 or 100 cubic centimeters of blood; the patient first complaining of tingling pains shooting over the body, a fullness in the head and an oppressive feeling about the precordium, and, later, an excruciating pain localized in the lumbar region. Slowly but perceptibly the face becomes suffused, a dark red to a cyanotic hue; respirations become somewhat labored, and the pulse rate, at first slow, sometimes suddenly drops as many as 20 to 30 beats a minute. The patient may lose consciousness for a few minutes. In one-half of our cases an urticarial eruption, generalized over the body, or limited to the face, appeared along with these symptoms. Later the pulse may become very rapid and thready; the skin becomes cold and clammy, and the patient's

condition is indeed grave. In from fifteen minutes to an hour, a chill occurs, followed by high fever, a temperature of 103 to 105°, in which the patient may become delirious. *Jaundice* may appear later. The macroscopic appearance of hæmoglobinuria is almost constant. In three such instances the symptoms were not recognized at the time of the transfusion and 500 cubic centimeters of blood were injected. All the patients died, two in one and three hours, respectively, following the transfusion, and one became comatose shortly afterward and died 30 hours later. In the other 9 instances the symptoms were early recognized and interpreted, and the transfusion was concluded after the injection of 50 to 100 cubic centimeters of blood. Adrenalin and atropin were administered with good effect. There was no mortality in this group.

Writers, notably Ottenberg and Kaliski, Bernheim, Brem, and others, for a number of years have been emphasizing the importance of preliminary blood tests, and yet today there are a few who advocate such a measure only when it is "convenient." The cases in our series point out most strikingly the fact that the injection of incompatible blood, namely, in which the donor's cells are agglutinable by the serum of the patient, is attended by the development of symptoms of the gravest nature, and that if these are not early recognized and the transfusion concluded before the injection of a large quantity of blood, fatal results are to be expected.

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THE TREATMENT OF CERTAIN TYPES OF ANORECTAL FISTULA

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THE successful operative treatment of anorectal fistula has offered difficulties which are nothing short of surprising, when we consider the brilliant achievements of the surgery of other regions during the past quarter of a century. The end-results have been far from satisfactory, even at the hands of the most expert, judging by the frequency of recurrences, postoperative complications, and sequelæ. Every surgeon must recollect instances from his own practice, in which radical operation, apparently thorough and complete, has been followed by humiliating failure, despite careful precaution during and after the operation. This is especially true of certain types of non-specific, complex, anorectal fistula, in which there is still some confusion as to what constitutes ideal treatment; we refer to those, which have one or more external openings on the skin, connected with one or more internal openings in the rectal wall, occurring simultaneously in both ischiorectal fossæ, from either two independent abscesses running their course at the same time, or originating from a single infective focus, by extension of the inflammation through the anococcygeal ligament. The proper operative management of such a condition requires skill and experience, for it is in this type of a case one is likely to meet not only a considerable percentage of recurrences, but distressing complications as well. Given such a problem, the surgeon is confronted with one of two alternatives: to follow up the tracts, and cut through the sphincters on both sides at one sitting, or permit one side to heal up first, before doing a secondary operation on the other, at some later date. Division of the sphincters in more than one place exposes the patient to the danger of incontinence, especially if both external and internal sphincter muscles have to be divided, while operation in two sittings subjects him to a double risk, and a prolonged convalescence, not to be lightly dismissed in a person already weakened from an exhausting suppurative process.

The writer has tried a plan which seeks to overcome these difficulties; it is based on the observation that, under certain conditions, a complete anorectal fistula will heal, and remain permanently closed, even if its internal opening is left undisturbed. Time and again do we see patients in our dispensary work, who have small sinuses which open into the rectal wall, and yet if at the time of operation the surgeon fails to locate such openings, it happens that some of these patients nevertheless are found to be cured permanently when examined months after-

wards, provided other conditions are favorable. This we believe may be accomplished in a majority of cases by careful attention to certain details, which may be set down as being fundamentally concerned in the successful treatment of anorectal fistula. It goes without saying, that the principles which apply to the treatment of a fistula (which is nothing more than a chronic abscess cavity contracted down to a thin, tubular tract) differ in no wise from those which medical science has found to be true in all other infections; they are constant physical values, modified only by local anatomical and physiological conditions. Failure to recognize this basic fact, has given us a false conception of the situation, wrongly influenced our methods and led to annoying complications. The keynote of the surgical treatment of abscess is prompt, radical, and thorough drainage, to permit the organism to rid itself of as many of its invading enemies as possible, prevent the absorption of their poisons into the blood, and stimulate and encourage repair. These conditions find their most favorable expression when the parts are kept at rest, because sick organs and diseased tissues will not repair readily, when their natural processes are disturbed by constant changes in the medium which surrounds them. There is no proof that re-infection from wound products and fæcal discharges play more than a secondary rôle in the treatment of fistula, provided only that good drainage is available; for the evolutionary tendency in an otherwise sound organism is toward repair and recovery, and not toward destruction and death, when favorable conditions are permitted to assert themselves.

Our plan then, is to cut into one of the external openings, and connect all of the tracts of one side with each other by suitable incisions, break up all pockets, trim away scar tissue, exuberant granulations, and as much of the edges of the wound as appear dead, or badly infected, attend to hæmostasis, and convert the wound into one single cavity with walls smooth and clean; then repeat the, process on the other side, *without, however, dividing the sphincter on either side.* This procedure provides for the necessary drainage. The next step is intended to immobilize the parts, by cutting through both sphincter muscles in the posterior median line, regardless of the location of the internal openings. This enables the parts to secure the rest they require to complete their healing, and does away with the necessity of the division of the sphincter on each side,, in two different places. Moreover the posterior incision is in a neutral position in respect to both fistulas, and will confer equal benefit to both, instead of much benefit to one, and but little to the other. It possesses the further advantage of enabling us to drain both ischiorectal fossæ through a single opening, and is less liable to be followed by damage to the fibers of the external sphincter. Because of their anatomical arrangement, these can be practically split in this situation, instead of being divided transversely. The posterior incision does not injure any vital parts, and being in a more dependent position when the patient is in bed, enables us to carry out drainage more easily; while anteriorly there are important organs in both male and female, besides dense fibromuscular structures which meet at the central tendon of the perineum, and are necessary to the integrity of the pelvic floor. Their division impairs the strength of the outlet, and causes sagging of the supporting muscles, an obvious objection in female patients.

The rest of the treatment is carried out with the same painstaking care which should be the rule in all cases of fistula. We have tried our plan in a limited number of bilateral anorectal, and so-called horseshoe fistula, and would recommend its use in suitable cases.

SUMMARY

The indications of successful treatment of of non-specific, complex, anorectal fistula occurring simultaneously on both sides, may be met by—

1. Adequate drainage, obtained by proper operative means.

2. Complete rest, by division of the muscles, not necessarily in line with the internal openings.

Given these, the internal openings may be trusted to take care of themselves.

A PRACTICAL CLASSIFICATION OF CUTANEOUS NEOPLASMS

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A CAREFUL examination of the ponderous forms of classification invented by the dermatologist and the simpler but more subtle arrangements that pure pathologists have evolved, leaves one with the feeling that, for the useful purpose of clinical diagnosis, the broadest and most obivious differentiation of skin tumors would be the most practical. Looking at the subject from this point of view, let us consider cutaneous neoplasms in three groups: i. e., (1) those upon the skin, (2) those in the skin, and (3) those beneath the skin.

Of course these broad divisions necessarily include intermediate or borderline zones; yet although the integrity of the classes is by no means inviolable, the form is so simple and so obivous that I shall attempt to justify its use by the clinician.

1. New-growths *upon the skin* we may define for our purpose as those projecting markedly beyond the surrounding surface plane, in which there is, visually or palpably evident, proliferation of the more superficial layers of the integument.

2. New-growths *in the skin* usually project little, if at all, beyond the surrounding surface plane but are more apparently connected with (or even a part of) the deeper dermal layers, as if the proliferation involved the entire thickness of the skin.

3. New-growths *beneath the skin* we must consider as including those cystic or solid tumors which, while connected with the skin and often elevating it beyond the surrounding surface plane, fail to exhibit any evident proliferation of the epidermis but rather a thinning of the overlying integument.

Papillomata and epitheliomata (especially those of the papillary type) fall readily into the first of the above classes.

Fibromata, keloids, granulomata, pigmented moles, angiomata of capillary type, the rare composite or fibro-epithelial tumors, melanocarcinomata, and sarcomata (except such metastases as may at first be entirely beneath the skin) belong in class 2.

Implantation, sebaceous and dermoid cysts, lipomata of pure or fibrous type and cavernous angiomata are classified with the third division.

During the past eight or nine years, morphological diagnoses have been recorded in the Department of Surgical Pathology on a few more than 350 new-growths of the skin, which may be grouped, according to our proposed classification, as follows:

1. Tumors upon the skin.

1. Papillomata			44
2. Epitheliomata	Basal cell	58	122
	Squamous cell	61	
	Papillary type	3	
			166

2. Tumors in the skin.

1. Fibromata	38
2. Sarcomata	24
3. Pigmented moles	28
4. Melanocarcinomata	12
5. Keloids	9
6. Granulomata	7
7. Fibro-epithelial or composite tumors	3
8. Capillary angiomata	2
	123

3. Tumors beneath the skin.

1. Angiomata (cavernous type)	20
2. Lipomata	5
3. Sebaceous cysts	18
4. Implantation cysts	15
5. Dermoid cysts	5
6. Carcinoma metastasis	1
	64

About 45 per cent of these tumors then are epitheliomata, sarcomata, and melanocarcinomata, and, if we omit the basal cell epitheliomata from this percentage, we find at least 28 per cent of the tumors presenting morphological characteristics of malignancy.

Fortunately, this does not at all accurately represent the relative frequency of incidence of malignant neoplasms of the skin; for it is well understood that many of the tumors re-

moved, whose benign character is clinically evident, (tumors such as lipomata and sebaceous cysts) are not sent to the laboratory for diagnosis.

On the other hand it must be remembered that a few tumors which, in their early stage, appear both clinically and morphologically to be non-malignant, give unmistakable evidence later (by metastasis) of their autonomous character. And these growths cannot but excite our peculiar interest.

Leaving their detailed consideration for a later moment, let us now examine the group of epitheliomata, sarcomata, and melanocarcinomata among the laboratory specimens with reference to the clinical diagnosis made by the sender of the specimen.

Among the 64 squamous epitheliomata there were 20 correct diagnoses and 27 cases in which the sender was either too indifferent or lacked the confidence to record his diagnosis. It is perhaps fair to argue that the sending of the specimen was inferential evidence that the operator at least suspected possible malignancy. Among the 58 basal-cell epitheliomata, there were 9 correct diagnoses, 13 incorrect diagnoses, and 36 cases with none. Of the 12 melanocarcinomata, 4 were incorrectly diagnosed and 4 had no diagnosis recorded. Five of the 24 sarcomata were correctly and 8 incorrectly named and 11 were not recorded.

Analyzing these figures, we find 25 per cent of straightforward, recorded mistakes, failures clinically to detect epithelioma; 26 per cent of failures to recognize basal-cell epithelioma; 33 per cent mistakes in melanocarcinoma and 33 per cent in sarcoma.

These facts are sufficiently striking to raise again the old question (most pertinent of cutaneous new-growths) "How do you know a malignant tumor when you see one?"

An attempt to answer leads us to a brief review of the clinical characteristics of cutaneous tumors in general without drawing any hair lines between hypertrophy and new-growth.

Situation, size and surface appearance, consistency, pigmentation or the lack of it, but above all the presence or absence of ulceration and the rate of growth are the important details to be observed in the examination of any skin tumor.

Following the outline of our tentative classification we may say that for purposes of clinical surgery, all new-growths *upon the skin* not epitheliomata may be called papillomata. Now, in any respectable treatise upon diseases of the skin, at least ten varieties of verruca or warts may be discovered; but most of these agree in their description with what surgeons are apt to designate papilloma; and this term connotes, lexicographically, "Any excresence upon the cutaneous or mucous surfaces," although morphologically speaking, papillomata are outgrowths from the surface having a covering layer of epithelium and a connective-tissue framework.

Such tumors, indeed, may be many in number, various in form, size, shape and appearance; but, no matter how different the histologic features, an accurate, positive clinical differentiation cannot be made between the varieties except it be based upon their situation or the history of their origin and course.

Exceptions, perhaps, to the very general rule are the cutaneous horns, rarely seen (but never afterward to be forgotten) and of little surgical significance except for the possibility of epitheliomatous change which, Lebert says, occurs in 12 per cent of the cases. Also the common corns and callosities (which are "what every woman knows") and which, though (like horns) of enormous etiological, histological and phylogenetic interest, are too familiar to require any mention further than to record that occasional confusion may arise between an early melanotic growth and a corn upon the sole of the foot, because of the minute hæmorrhagic extravasations that are frequently found simulating pigment in the deeper layer of the latter.

Now epitheliomata are found, in our experience, most frequently upon the forehead (15 per cent) the lips (15 per cent), and the cheek (14 per cent); but while the basal-cell favor the cheek, nose and forehead, they may occur on any part of the surface. Nor in the early stage is there anything absolutely characteristic in their size, shape, or consistency. True they are generally hard. But so

are many papillomata and it is not until the former are, so to speak, full blown and well developed (especially in the basal-cell type) that evident acceleration of the rate of growths and the development of ulceration afford fairly definite evidence of their wicked identity.

Among the tumors *in the skin* fibromata and sarcomata so closely resemble each other at the period when local removal has curative possibilities that even under the microscope a diagnosis may be doubtful and the elements are so mixed that the term fibrosarcoma has arisen to conceal our ignorance. The same may be said with regard to angiomata, although of course the perfectly typical instances may be easy to differentiate.

Keloids are usually so straightforward as to be positively uninteresting (from a diagnostic point of view), but we have at least one specimen of clinical keloid that turned out to be, on microscopic examination, a basal-cell epithelioma.

But any fungating tumor may be mistaken for a granuloma; and between a melanotic carcinoma and a pigmented mole no pathognomonic symptom can be stated that will definitely point to removal for malignancy while yet local removal is of any value.

Tumors *beneath the skin* present some diagnostic dfficulties as between certain angiomata and lipomata, but these are unimportant from the standpoint of mortality; while sebaceous, implantation and dermoid cysts, although exciting to the diletante to argue over, for the most part, share the same inglorious degree of safety.

If a wearying repetition of too well known symptoms has been avoided, enough has yet perhaps been said to indicate that, although in what might be called, the "developed" stages, acceleration of growth rate and occurrence of ulceration are most pointedly suggestive of danger: in the developing stages, on the other hand, a positive, correct diagnosis between the benign and a malignant tumor of the skin can rarely be expected. If this be true, and our records speak loudly in its affirmation, it follows as the night the day, that the only question a clinical surgeon has the right to haggle over is whether the offensive excresence is a real new-growth or not, i. e., whether it has grown since first noticed.

If it be, then it must come out, for, to paraphrase the old story of the good Indian, the only permanently benign tumor is one that has been bottled early.

And now, lest this presentation may have robbed the subject of its proper gravity, your attention is most seriously invited to two propositions.

1. That every new-growth of the skin should be excised as soon as one can decide that it is a new-growth.

2. That if any suspicion of present malignancy is entertained and local excision is thought adequate, a much wider incision of the tumor should be planned than has commonly been practiced in the past. And in support of these propositions I have selected, from a number of others, filed in the laboratory, three malignant cutaneous neoplasms with histories of their courses.

1. No. 1830 illustrates the danger of waiting for rapid growth and ulceration.

2. No. 2775 illustrates the same.

3. No. 2546 illustrates the futility of close excision.

Fannie Bernicker, No. 2775. Admitted Febuary 5, 1914, Roosevelt Hospital. History No. A4692. Chief complaint, sore on left heel and swelling in left groin. Six months ago, patient first noticed a small reddened swelling on left heel. There was some tenderness and the skin was rubbed off, and there was occasional bleeding but no pus. The swelling did not grow perceptibly larger but the surface became ulcerated and did not heal and there developed little black nodules about the ulceration. Three weeks ago, she went to Vanderbilt Clinic. She was seen by Dr. Brewer, who made a diagnosis of papilloma. The entire area was excised and the specimen sent to Dr. Clarke (January, 1914) who made a diagnosis of melanocarcinoma.

The outer margins healed, but the central part remained an ulcerating area. Since the excision of the mass in the foot, the patient has noticed presence of small nodules in the left groin, associated with sensations of drawing and pressing in the inguinal region and indefinite pain in the leg. She had no difficulty in walking, but believes she has lost a little in weight.

Examination of left heel, inner aspect, shows an ulcerating area about the size of a five cent piece. The edges are slightly raised and show small dark areas with brown pigment. On the skin, in the

immediate neighborhood, are three raised pigmented nodules.

In left groin are palpable two distinct, firm masses about the size of an English walnut; not red or tender, no fluctuation; seem firmly attached to deep structures. Few small palpable kernels in right groin.

First operation Febuary 6, six months after discovery of growth. Two glands excised and sent to laboratory for frozen section. Report chronic inflammation. Further examination of glands showed melanocarcinoma.

Second operation, Febuary 16. Amputation at hip done under the impression that there was yet no metastasis in glands.

A letter from Dr. S. Pollitzer to Dr. Russell of the Roosevelt Hospital, received July 25, 1914, twelve months after tumor was first noticed, six months after first excision reads:

> I learn from Dr. Brewer that a case which I saw recently had been under your care at the Roosevelt Hospital last January. An elderly woman, Mrs. Bernicker, had a malignant growth near the ankle. You amputated at the hip-joint. Within a month of her discharge from the hospital, as nearly as I can get the facts, she began to develop little tumors under the epidermis. When I saw her, a few weeks ago, she had about fifty such nodules, varying in size from a small shot to a walnut, freely movable, scattered over the integument of the trunk and neck; color of skin normal. I excised one of these tumors and enclose a section.
>
> The woman complains of various internal pains. No visceral lesions can be made out.

Skin nodules July, 1914, show a small focal area forming a definite tumor of epitheloid cells with supporting fibrous stroma. No pigment. Dr. Pollitzer reports that she died, date unknown.

Henry Kelly, 73 years old. No. 2546. Epithelioma of elbow region; metastasis in axillary lymph nodes. Death from visceral metastasis and spinal metastasis twenty-three months after excision of primary growth and, about twenty-five months after it began to grow rapidly.

Primary History. May 22, 1913, from Vanderbilt Clinic. Fungating mass 1⅛ inches in diameter on outer side of left forearm just below elbow. Commenced three years ago as a small mole. Grown to present size in two months, i. e., rapid growth for two months.

Sent to the Roosevelt Hospital from Vanderbilt Clinic, January, 1914, (eight months after excision of primary growth on arm). Then had mass of stony hard enlarged nodes in left axilla attached to deeper part. On operation nodes found not adherent to sheath of axillary vein. Nodes excised as thoroughly as possible. Wound healed *per primam.*

March, 1914 (two months later) no plapable recurrence in axilla but he spit up a little blood and complains of occasional sharp pain in left shoulder region. (Query—Lung metastasis, or exacerbation of chronic bronchitis?)

April, 1914, (three months later). Recurrence (local) noted in axilla. On operation, gristly hard mass found adherent to sheath of axillary vein. Mass excised as completely as possible. (Vessels should have been removed also.) Wound healed *per primam.*

July, 1914, (six months later). Second local recurrence was observed in *scar* and deep axilla. Dr. Hotchkiss operated. A mass was found involving the axillary vessels which were almost completely surrounded by it and so compressed as to be nearly obliterated. Neoplasm and about four inches of axillary vessels removed *en masse.* Wound never entirely healed.

September, 1914, (8 months later). The patient complained of pain in both shoulders and sides of chest.—(Query—Spinal metastasis?) Some induration of margin of unhealed wound. Loss of flesh and strength noted. Codeine ¼ grain p. r. n. begun.

October, 1914, (9 months later). The patient was suffering much pain. General condition decidedly cachectic. Evident local recurrence in unhealed suppurating skin wound and one nodule elevated and size of hazel nut in anterior axillary fold and similar one in posterior fold. Now taking morphine sulphate 1½ grain every day.

December, 1914, (11 months later). Death rather sudden but with no definite ascertainable symptoms of hæmorrhage or embolus. He had been taking less and less nourishment lately. Not able to leave bed past three days.

Bertha Vanderen, age 55 years, German, No. 1830. Sixteen years ago (after childbirth) the patient noticed warts on right side of forehead which were dark colored. The skin around them gradually became dark. A few months ago, lower wart began to grow high and its top to ulcerate. Fourteen days ago the patient noticed a lump on the right cheek, this has increased in size and become tender. Two or three other small lumps also appeared in neck below the angle of jaw. One slightly tender. On right side of forehead, just below the hairline, is a dark brown area about two inches in diameter, which looks like a birthmark. Near the center is an ulcerated, papillomatous growth nearly one-fourth of an inch in diameter with considerable purulent discharge. It is friable and bleeds easily. Another papilloma appears in upper anterior part of the dark area, but this is smaller and not ulcerated. In front of the auricle is an oval, smooth, tender mass (apparently parotid lymph node) about one-half by three-quarters inch, and below the angle of the jaw are several others.

On the second day after admission, signs of suppuration appeared on the neck and an incision was made. The parotid node was smaller and softer.

On the twelfth day after admission the area on the forehead was excised.

On the forty-second day the lump in the parotid was excised.

About three months after excision of the primary growth, a recurrence was noted about the excised

area. Seven months later, recurrence in neck. An attempt was made to remove this, but it was too deep and involved great vessels and nerves. From this time on, growth became very rapid, finally causing constant, severe pain, dyspnœa and dysphagia. Many small local recurrences dotted her forehead and right side of face.

Nine months after the original operation (about eleven months after tumor began to grow fast) a block dissection of neck done for relief of dyspnœa. Patient died on operating table.

With these three fatal examples before us of the many mistakes that have been honestly recorded, and bearing in mind the ease and safety of early removal of skin tumors, is it not fair to ask the general practitioner to forget the minute differences between the ten varieties of warts and remember only that, of cutaneous neoplasms in or upon the skin, a large percentage are or will become malignant?

A source of chronic irritation removed, a precancerous lesion excised is more valuable by far than many a treatment of developed cancer if there be any truth in the old adage that "an ounce of prevention is worth a pound of cure."

FURTHER STUDIES IN POSTOPERATIVE PNEUMONITIS[1]

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Evacuation Hospital No. 10

DURING the years 1915 and 1916, the subject of postoperative pneumonitis at the Presbyterian Hospital was carefully studied by Whipple (1) and reported by him in SURGERY, GYNECOLOGY and OBSTETRICS, January, 1918. The work has been continued for another year for comparison with the statistics of the preceding two years and also to observe the effect of certain prophylactic measures which had been instituted. A special analysis sheet has been used in each case of postoperative pneumonitis to insure a uniformity in ascertaining data. A copy of this sheet is again published with this paper since it shows the line along which our investigations have run and it may be of interest in the development of comparative work by others (Fig. 1).

There has recently appeared in SURGERY, GYNECOLOGY and OBSTETRICS, a very comprehensive study of postoperative pulmonary complications by Cutler and Morton (2). A considerable part of this work deals with pneumothorax, mediastinitis, and pulmonary embolism of mechanical origin, and which of necessity does not come within the scope of this present article, dealing only with inflammatory conditions of the lungs following surgical operations. It will be interesting to contrast certain of the statistics of Cutler and Morton relating to postoperative pneumonia with those of the 1915-1916, and 1917 series of the Presbyterian Hospital.

Previous to Whipple's work there had been reported no series of postoperative pulmonary inflammations in which the bacteriology had been carefully studied. Roentgenography as a routine procedure in all cases had likewise been neglected and the bedside history analysis of the complication had been very meager. With these facts lacking, any work on postoperative pneumonitis must be very incomplete.

It seems advisable to divide quite arbitrarily, postoperative pneumonitis into at least three types.

1. The true postoperative pneumonia, often called ether pneumonia: a disease coming on within the first few days after operation, accompanied by cough, rise in temperature, usually due to some exposure.

2. Embolic pneumonia, occurring at any time after operation and as far as is known, one of the accidents of the postoperative course.

3. Terminal pneumonia, occurring usually as an incident in patients *in extremis* after a short or protracted postoperative course.

[1]Under grant from the Harriman Research Fund.

The Presbyterian Hospital
IN THE CITY OF NEW YORK

Ward..... *History No*.....

Name.....*Age*.....*Division*.....

Operation
Operator, Dr. **Anæsthetist** **Time of Anæsthesia**
Untoward Symptoms Occurring During Anæsthesia:
Cyanosis (1), Vomiting (2), Excessive mucus (3), Aspiration of vomitus (4).
History of Recent Concurrent Respiratory Trouble Before Entering Hospital:
Recent cold (1), Cough (2), Bronchitis (3), Tonsillitis (4).
Exposure during examination (1), following admission bath (2), from operating room to ward with length of time (3), after operation till patient is in bed (4), in ward after operation (5).
Mode of Life and Habits of Patient:
Works in-doors (1), out-doors (2), wears cotton underwear (3), woolen underwear, one suit (4), more than one suit (5), takes cold baths (6), hot baths (7).
Number of blankets patient sleeps under, 1, 2, 3, 4, etc.
Patient Has on Admission, Physical Signs of Inflamed Condition of Respiratory Tract:
Rhinitis (1), Tonsillitis (2), Pharyngitis (3), Laryngitis (4), Bronchitis (5), Pulmonary Tuberculosis (6).
Cardio Vascular and Renal Systems on Admission:
Normal (1), Valvular Disease (2), Arrhythmia (3), Tachycardia (4), Insufficiency (5), Thickened Peripheral Arteries (6), Hypertension with Blood Pressure (7), Nephritis (8).
Disease:
Symptoms of Onset in Order of Appearance, With Date (underline important one):
Cough (1), Pain in chest (2), Dyspnœa (3), Chill (4), Rapid respiration (5), Cyanosis (6), Temperature (7), Rusty sputum (8).
Marked Symptoms during Attack (underline important one):
Cough (1), Pain in chest (2), Rapid respiration (3), Cyanosis (4), Rusty sputum (5), Herpes (6).
Temperature Remained Over 102° F. (note number of days, 1, 2, 3, 4, 5, etc.):
Blood Count, Date **W. B. C.** **Differential**
Signs of Congestion or Consolidation Made Out in,
R. U. L. (1), R. M. L. (2), R. L. L. (3), L. U. L. (4), L. L. L. (5), Entire Right (6), Entire Left (7).
Congestion. Date
Consolidation, lobular, (1).
Consolidation, lobar, (2).
X-ray shadow with no signs of consolidation. Date
Signs of consolidation with no X-ray shadow. Date
X-ray shadow and signs of consolidation agree. Date
X-ray showed shadow before signs of consolidation appeared.
X-ray showed wedge shaped shadow, Date
No X-ray taken.
Cardio Vascular and Renal Systems During the Disease.
Blood Pressure:
Pulse: Strong (1), Weak (2), Regular (3), Irregular (4), Rate
Heart: Arrhythmia (1), Fibrillation, etc. (2), Tachycardia (3), Insufficiency (4)
Kidneys:
Albuminuria (1), Nephritis (2).
Complications:
Empyæma (1), Lung abscess (2), Sero-fibrinous pleurisy (3), Otitis (4), Peritoneal abscess (5), Pneumococcus peritonitis, local (6), Diffuse (7).
Postoperative Respiratory Disease Other Than Pneumonia:
Bronchitis (1), Pleurisy (2), Embolus (3).
Bacteriology:
Pneumococcus I (1), II (2), III (3), IV (4), Non-hæmolytic Streptococcus (5), Hæmolytic Streptococcus (6), Bacillus Influenza (7), Friedlander Bacillus (8), No organism recovered (9).
Ante-operative sputum. Date
Postoperative sputum. Date
Blood culture. Date
Agglutinations.
Blood with sputum Ante-operative (1), Postoperative (2).
Prophylactic Measures:
Pneumonia bed jacket (1), Digitalis M XV 4 i. d. (2), Bath Rules (3), Counter irritation with liniments (4)
Treatment:
Open air (1), Serum (2), Croup tent (3), Digitalis (4), Other stimulation.
Final Result: **Autopsy:**

Fig. 1.

This is more often discovered by the pathologist than by the clinician. There are often no physical signs, usually no abrupt rise in temperature and no cough. This type of pneumonia is merely mentioned in this article as a matter of interest and will be summarily dismissed. It is outside the scope of any work attempting to consider the prevention of postoperative pneumonitis. During the year, five of these terminal pneumonias, usually bronchopneumonia, were found by the pathologist in autopsies on

surgical patients. None of them presented clinical signs.

There were noted several cases of postoperative bronchitis during the year. These were uniformly mild, clearing up within two or three days.

Postoperative pleurisy with effusion occurred once. The patient had severe pain in the chest with a temperature of 103.° Signs of fluid appeared at the right base and 200 cubic centimeters were aspirated.

In this present work only pneumonitis *per se*, exclusive of those terminal pneumonias not recognized clinically, will be dealt with, in order to compare results with those obtained by Whipple. The embolic pneumonias will be considered separately, frequently contrasting them with the postoperative pneumonias.

INCIDENCE

The postoperative pneumonitis encountered at the Presbyterian Hospital during 1917 is divided as follows:

Postoperative pneumonia	58
Postoperative embolic pneumonia	7
Total cases	65

Out of 1940 operations during the year, this gives a morbidity percentage of 3.3, which is high, but at the same time there has been a disappearance of the unexplained so-called "postoperative reaction." Every case with a temperature of 101° or over after operation, without the presence of known infection, has been carefully examined for signs of pulmonary involvement and has been radiographed. The latter procedure not infrequently gives the clue to the rise in temperature some time before physical signs appear. In a number of cases these signs never do appear. The increasing morbidity percentage of postoperative pneumonia in our series is, we are convinced, a tribute to greater diagnostic accuracy and keener observation rather than any actual increase. The physical signs in this series have in no instance been discovered without turning the patient and listening at the base of the lungs.

Referring to Table I, the relation of appearance to (1) sex, (2) season and (3) age, may be appreciated.

TABLE I

	Postoperative Pneumonias Number of Cases	Embolic Pneumonias Number of Cases
Sex		
Males	45	4
Females	13	3
	58	7
Months of the year		
January	5	1
February	7	
March	7	1
April	7	
May	6	1
June	2	
July	2	1
August	6	1
September	4	1
October	1	
November	5	1
December	6	
	58	7
In decades		
1–9		
10–19	8	
20–29	17	
30–39	13	5
40–49	8	
50–59	8	2
60–69	4	
70–79		
	58	7

1. *Sex.* While the embolic pneumonias were nearly evenly divided between men and women, the postoperative pneumonias were present in men four times as frequently as in the women. It may possibly be due to the fact that the women are less exposed to coughs and colds than men and that the oropharynx is not so chronically inflamed in women.

2. *Season.* The influence of the season on the occurrence of the postoperative pneumonias is seen when 65 per cent, practically two-thirds of the cases, occurred during the six winter and spring months. No explanation for the relatively large number of postoperative pneumonias in August can be advanced unless it was due to a general relaxation of phrophylactic vigilance toward the end of the summer. The embolic pneumonias were widely distributed, no two within the same month. This is what might be expected.

3. *Age.* Fifty-two per cent of the cases of postoperative and embolic pneumonia occurred in the third and fourth decades, agreeing almost exactly with Whipple's findings. Only four of the patients were over 60 years of age. These figures differ quite materially from those of Cutler and Morton. In their series of 40 postoperative pneumonias, 67 per cent were over 40 years of age.

PREDISPOSING FACTORS

Among the predisposing factors of postoperative pneumonia are the following: (A) coughs, colds, etc., previous to or on admission to the hospital; exposure to cold while in the hospital; (B) condition of the patient; (C) type of operation; (D) anæsthesia.

A. *Coughs, colds and exposure.* The great importance of this subject warrants a detailed discussion (see Table II). Of the sixteen patients who gave a history of having had a cold before admission, three had previously been sent home to recover and returned apparently cured. None of these patients showed any physical signs of inflammation of the respiratory tract. The risk of catching cold from exposure, following the admission bath, has been largely eliminated during the year. Two women patients caught cold from failure of their hair to dry properly after their bath. The electric dryer was installed directly after this. Exposure after operation from insufficient covering, draughts from windows, etc., claims its fair share of victims. Some patients, owing to restlessness when coming out of anæsthesia, are of course very difficult to keep properly protected against exposure. The five patients entering the hospital with acute inflammation of the respiratory tract were exceedingly poor risks from the standpoint of pneumonia, but they were all emergency operations and the surgeon was left no choice in the matter. The low grade inflammations of the respiratory tract noted, range from hypertrophied tonsils to chronic bronchitis and are doubtless important predisposing factors. These chronic respiratory ailments are extremely prevalent and the only way to be sure of their importance would be to note them carefully in the physical examinations of all patients about to undergo operation and see what percentage developed postoperative respiratory disease.

TABLE II

Patients giving history of recent cold or cough, 2 days to a month before admission	16
Patients giving history of exposure following admission bath or change from heavy underwear to their ward clothing	4
Patients giving a history of exposure from open windows, insufficient covers, etc., after operation.	11
Patients having on admission physical signs of an acute inflammation of the respiratory tract, acute bronchitis, acute tonsillitis, acute rhinitis, etc.	5
Patients having on admission physical signs of low grade or chronic inflammation of the respiratory tract, such as hypertrophied tonsils, chronic bronchitis, red throat, etc	18
Total cases	54

B. *Condition of patient.* This series offers a relatively small number of cases of the aged and infirm, but there are several instances of those worn down by the cachexia of malignancy or constitutional disease, falling an easy prey to postoperative pneumonia. Under the heading of condition of the patient, it will be well to consider the average type which comes to operation at the Presbyterian Hospital. Of the 65 cases in this series, the occupation of 62 was ascertained. Of these, 53 worked indoors while only 9 worked in the open air. The great majority stated that they changed from heavy to light underwear according to the season and took hot or cold baths by the same token. In regard to general physical condition, 59 of the patients were examined and 78 per cent of these were recorded as having normal cardiovascular and renal functions in so far as routine physical examinations and urinalysis showed. Six patients had albuminuria, three with casts; one patient had slight cardiac insufficiency and another hypertension of 195-105. It will thus be seen that roughly speaking, these patients were in good physical condition, though as a class they are quite susceptible to changes in temperature.

C. *Type of operation* (Table III). Eighty-six per cent of the operations performed in this series were cœliotomies and a majority of these were of a relatively simple nature,

TABLE III.—SUMMARY OF OPERATIONS

	Cases
Hernia, inguinal and ventral	19
Appendicectomy	16
Pelvic-gynecological	10
Gall-bladder	7
Exploratory cœliotomy	2
Gastrostomy	1
Enterocolostomy	1
Incision and drainage of abscesses (extraperitoneal)	3
Mastectomy for carcinoma	1
Skingraft following mastectomy	1
Thyroid, excision of cyst	1
Decompression, fracture of skull	1
Phlebectomy	1
Laminectomy	1
Total acess	65
Total cœliotomies	56

such as hernia repair and removal of simple appendix. These findings lend added weight to the argument that those operations which tend to limit respirations by splinting the abdominal or thoracic muscles, predispose to postoperative pneumonia. In Whipple's series 90 per cent of the operations were cœliotomies. Cutler and Morton likewise ascribe to restricted respiration the high percentage of postoperative pneumonia following cœliotomy, particularly after epigastric incisions. In this series there were eight epigastric incisions, which is certainly a relatively high percentage of the total of such incisions.

D. *Anæsthesia.* Time was when the entire blame for postoperative pneumonia was laid at the door of anæsthesia. "Ether pneumonia" was a term well known and widely circulated. The surgeon was only too willing to shift the blame to the anæsthetist or consider the pneumonia as one of those unavoidable accidents of the postoperative course. That the anæsthetic *per se* does not cause the pneumonia is no longer doubted. The irritation of the anæsthetic does, however, prepare the way for organisms already present in the upper respiratory tract by lowering the resistance of the lung tissue. The commonest organism present in the mouth is the pneumococcus group IV, which is, indeed, the one most commonly responsible for postoperative pneumonia. Patients markedly obstructed with mucus during the anæsthetic may very easily aspirate a considerable quantity loaded with organisms from the mouth. In six cases it was noted that there was considerable mucus, causing obstruction to breathing. Cyanosis due to obstructed respirations was present in 14 cases. This condition is simply an indication of insufficient aeration or oxygenation of the blood and a congestion of the pulmonary vessels and favors a descending infection according to Whipple. The anæsthetic of choice has been gas and ether, by the closed method with the Bennett apparatus, though recently there has been a trend toward ether by the drop method. This latter certainly tends less toward cyanosis. Ether has rarely been used during the year where there was any inflammatory condition of the respiratory tract that was considered a risk from the standpoint of postoperative pneumonia. Gas and oxygen, local anæsthesia and chloroform are used in such cases. Table IV, shows the number of cases developing pneumonia after the various anæsthetics. The number following chloroform is large in proportion to the total number of chloroform anæsthesias, but these cases were almost invariably bad risks.

TABLE IV

	Cases
Gas-ether sequence, closed method	44
Gas-oxygen-ether	7
Ether, drop method	7
Ether-intrapharyngeal	3
Gas-oxygen	2
Chloroform	2
Total cases	65

The cases were divided among the various anæsthetists, professional and members of the house staff about in proportion to the number of anæsthetics given by each. The length of anæsthesis had very little, if any, influence. The shortest in the series was three minutes and the longest two hours and twenty minutes, with an average of sixty-two minutes.

Before further detailed consideration of the postoperative pneumonias encountered in this series, the routine followed in their study should be understood. A pre-operative sputum examination was made on all patients. As soon as a patient came under suspicion of postoperative pneumonia, whether for a sudden rise in temperature, cough or

pain in the chest, with or without the presence of physical signs, the following measures were taken: (1) postoperative sputum examination; (2) blood count, leucocytes and differential; (3) blood culture; (4) urine for pneumococcus precipitation test (this latter has been in use only since September 1917); (5) roentgenograph of lungs.

The type of postoperative pneumonia which it is our object to emphasize, has most frequently occurred in otherwise healthy young adults. In our 58 cases an attempt was made to subdivide them into lobar and lobular with the aid of the roentgenograph to check up physical findings. This is a rather crude method of stating the extent of the consolidation. Twenty-six of the cases were lobular and twenty-eight lobar; four were undetermined.

SYMPTOMATOLOGY

(SEE TABLE V)

A typical case of postoperative pneumonia has very definite characteristics of its own. The average time of onset is 48 hours after operation, though that of 55 per cent of the cases occurred within 24 hours after operation. A sudden rise in temperature to about 103° or cough, or less frequently pain in the chest, may mark the onset. There is rarely an initial chill. During the course of the disease the temperature falls by lysis within a day or two. In this series it remained over 102° for an average of only 2.5 days. The most important symptom during this period is cough, as shown in 66 per cent of the cases, followed by rapid respiration and pain in the chest, respectively. In the meantime signs of consolidation usually appear at either base and the roentgenogram shows the shadow. This disease *per se*, unaccompanied by cachexia, debility, or by any other constitutional disturbance, has not proven itself a dangerous complication in this present series.

In strong contrast to the foregoing, embolic pneumonia has likewise very definite earmarks. The average day of onset was the twelfth day after operation. The most important symptom of onset was pain in the chest in six out of the seven cases. The temperature falls by lysis after persisting for seven or eight days. The pain in the chest continues as the most important symptom throughout. Cough is usually present and in about one-third of the cases blood-tinged sputum was noted. The signs in the chest are those of consolidation often preceded by pleuritic friction rubs. The roentgenograms checked up the physical findings in every case in which it was employed.

TABLE V.—SYMPTOMS

Symptoms of Onset	Postoperative Pneumonias 58 Cases	Embolic 7 Cases
Cough	41	1
Temperature	39	6
Pain in chest	19	7
Rapid respiration	32	1
Cyanosis	10	1
Dyspnœa	9	1
Chill	3	1
Rusty sputum		1
Average day of onset after operation	2.4	7
Symptoms during attack		
Cough	44	5
Pain in chest	16	5
Rapid respiration	40	5
Cyanosis	6	2
Dyspnœa		
Rusty sputum		2
Herpes	1	1
Temperature remained over 102°.		
Never reached 102°	11	
1 day	11	2
2 days	17	0
3 days	4	1
4 days	7	
5 days	3	1
6 days	2	1
8 days	1	0
9 days	1	0
10 days	1	
15 days	0	1
19 days	0	1

PHYSICAL SIGNS

The physical signs of consolidation of postoperative pneumonia, in our experience, have invariably been found in one or the other lower lobe, usually at the extreme base. These signs may be easily missed unless the patient is turned over on his side and the bases are carefully searched with percussion and auscultation. Any patient can be turned after operation without danger if proper care and gentleness are exercised. In the postoperative pneumonias the signs usually appear with the onset or shortly after, in about 70 per cent of the cases within the first 24

hours. In the embolic pneumonias of this series the signs of consolidation were a little slower to appear, 43 per cent occurring from the third day to the fifth day after the onset of the disease. The right lower lobe was most frequently involved, being solely affected in 27 out of the 54 cases of postoperative pneumonia and in conjunction with the left lower lobe in 10 or more cases, while the left lower lobe was involved alone in but 15 cases. Among the embolic pneumonias the bases were also the chosen sites, though in one case the right upper and right middle lobe were involved. These signs frequently appeared first as a slight congestion with a few râles, followed by dullness and later, by frank bronchial signs of consolidation. They are often fleeting, clearing up within a day or so in distinction to the regular medical lobar pneumonia, due to pneumococcus groups I, II, or III.

In the meantime, as a rule, the heart shows but very slight signs of embarrassment in a typical postoperative pneumonia. The pulse is always slightly increased in rate, though of good quality and regular. There was marked irregularity of the pulse in but five cases in this series, three of which proved fatal. Tachycardia was noted twice and an auricular fibrillation once. The blood pressure, recorded in 31 cases was quite within normal limits of systolic and diastolic pressure, in all except one case of hypertension and three of slightly diminished tension.

TABLE VI.—PHYSICAL SIGNS AND ROENTGENOGRAPHIC FINDINGS

	Postoperative Pneumonias	Embolic
Signs of consolidation elicited	54	7
Signs consolidation not elicited	4	0
Lobar	28	3
Lobular	26	4
Right lower lobe	27	3
Left lower lobe	15	2
Right and left lower lobe	10	1
Entire left side	1	
Left lower lobe and left upper lobe	1	
Right upper lobe and right middle lobe		1
Number of cases roentgenographed	51	5
Number of cases not roentgenographed	7	2
X-ray shadow with no signs of consolidation	4	
Signs of consolidation with no X-ray shadow	6	
X-ray shadow and signs of consolidation agreed	41	5
X-ray shadow present before signs appeared	6	
Roentgenographic shadow wedgeshaped	7	

THE ROENTGENOGRAM IN RELATION TO SIGNS OF CONSOLIDATION

Roentgenography was employed as an aid to diagnosis in 56 out of the 65 cases. It has been our purpose to subject every patient suspected of postoperative pneumonia of either variety to this procedure. Of the nine who escaped, four were private patients on whom permission was withheld. The remaining five failures represent three patients considered too sick to move and two overlooked through careless failure to carry out orders.

The importance of roentgenography cannot be overestimated as a diagnostic procedure in the study of postoperative pneumonia. In four cases there could have been no diagnosis made without roentgenography, for the signs of consolidation never appeared though the shadow was perfectly frank, and the customary symptoms were present. The shadow in the lung not infrequently precedes the advent of physical signs of consolidation. With the knowledge that a shadow is present a careful search for the signs is continued until they may be found.

In a certain number of cases there are signs of consolidation present with no shadow displayed by roentgenography. In this series there were six of these cases. In three the signs were at the left base where a small shadow of consolidation might easily be obscured by the heart shadow. The remaining three were at the right base, but one of these was not roentgenographed until four days after the signs appeared, which was evidently too late to show a shadow. Just as the physical signs of consolidation are transitory, so is the shadow, and there should be no delay in roentgenographing the patient under suspicion. The shadow appearing at the right base offers better opportunity to study its contour. In seven cases it was noted to be wedgeshaped with the base of the wedge

pointing downward and outward. This peculiarity has been mentioned by Whipple and others.

In the great majority of cases the roentgenogram agrees with the physical signs, proving it a valuable and conclusive aid in the diagnosis. The details of the roentgenographic shadow in relation to physical signs may be seen in Table VI.

COMPLICATIONS

Complications directly due to the pneumonitis arose in six cases of the postoperative and two of the embolic pneumonias. The most frequent of these complications was serofibrinous pleurisy occurring in three postoperative pneumonias. In none of these was an organism recovered on culturing the fluid. Another postoperative pneumonia developed a serofibrinous pleurisy from the fluid of which a gram-positive diplococcus was recovered. This same patient also had a marked localized pneumococcus peritonitis and was jaundiced. Jaundice occurred in one other patient. These pleural effusions mentioned were uniformly small and relatively unimportant.

The most serious complication noted among the postoperative pneumonias was a lung abscess following a delayed resolution for five weeks. This patient eventually recovered without operative treatment.

The embolic pneumonias had far more spectacular complications. One patient with a hæmolytic streptococcus in the blood culture and sputum developed an empyema which was drained by rib resection and thoracotomy. The pus likewise yielded a pure culture of hæmolytic streptococcus. A second embolic pneumonia with a staphylococcus aureus present in his blood culture developed a small pleural effusion. The fluid removed was tinged with blood which very probably accounts for the presence of the staphylococcus aureus in the culture. The effusion soon cleared up.

BACTERIOLOGY

In the study of postoperative pneumonitis, the greatest importance has been placed upon this aspect of the work. We have been fortunate in having the services of a thoroughly scientific bacteriologist, Miss Marion Olmstead, who has followed the subject of postoperative pneumonia during the entire three years covered by the present work and that of Whipple. We have been particularly anxious to learn what organism or organisms are responsible as direct causative factors in the disease. This has meant a large increase in the routine work of the bacteriologists, but has been carried out with a splendid spirit of co-operation. The pre-operative and postoperative sputum examinations and blood cultures and blood agglutination should have been done in every case as was intended. The failures represent a certain carelessness on the part of the nursing and house staff, and include a few private patients on whom permission to obtain specimens was withheld. The urine precipitation test was not adopted until September, 1917, but since then has been tried consistently.

1. *Sputum* (see Table VII). A little less than half of the pre-operative sputum examinations showed no pneumococcus present, but after operation this was reduced to one-sixth. Of the organisms present the pneumococcus group IV holds the pre-eminent place, being present in 32 per cent before operation and in 57 per cent after operation in cases developing postoperative pneumonitis. The other groups of pneumococcus were all represented except group I. Hæmolytic streptococcus and bacillus mucosus capsulatus also were occasionally found. In 17 cases the pre-operative and postoperative sputum examinations showed the same organism, 10 of these showing pneumococcus IV.

2. *Blood culture.* This test was made in fifty-one cases of postoperative pneumonia and found positive in but three. Pneumococcus group IV was present in the blood of one patient, non-hæmolytic streptococcus in that of another, both of whom recovered, and finally pneumococcus group III was found in the blood of a third who died.

In the embolic pneumonias with two positive blood cultures out of seven, the incidence was much greater in proportion, as might be expected. In one case hæmolytic streptococcus was present in the blood both before

TABLE VII.—SPUTUM EXAMINATIONS

Postoperative Pneumonias	Total Cases Examined	No. Organisms Recovered	Pneumococcus IV	Pneumococcus III	Pneumococcus II Atypical	Pneumococcus II	Pneumococcus IV, III	Hæmolytic Streptococcus	Bac. Mucos. Caps.	Bacillus Muc. Caps. Pneumoc. IV.
Pre-operative sputum	46	20	15	4	4	1		1	1	
Postoperative sputum	54	7	31	4	4	1	1	2	3	1
Pre- and postoperative coincided with same organisms	17		10	2	2	1		1	1	
Embolic Pneumonias										
Pre-operative sputum	5	3	1	1						
Postoperative sputum	7	2	3	1				1		
Pre- and postoperative coincided with same organisms	2		1	1						

TABLE VIII.—PNEUMOCOCCUS AGGLUTINATION

Case No.	Pre-operative Sputum	Postoperative Sputum	Agglutination	Test
1	No organism	Pneumococcus IV	+	3rd
2	Not examined	Pneumococcus IV	+	3rd
3	No organism	Pneumococcus IV	+	2nd
4	Pneumococcus IV	Pneumococcus IV (different strain)	With postoperative strain	4th
5	Not examined	Pneumococcus IV	+	3rd
6	Pneumococcus II (stypical)	Pneumococcus II (atypical)	+	4th
7	Pneumococcus II (atypical)	Pneumococcus II (atypical)	+	3rd
8	Pneumococcus IV	Pneumococcus IV	+	1st
9	Not examined	Pneumococcus IV	+	3rd
10	Pneumococcus IV	Pneumococcus IV (different strain)	With pre-operative strain	4th

and after the operation which merely consisted of incision and drainage of abscesses. In the second case staphylococcus aureus was found in the blood of a paraplegia with a huge sacral decubitus. The operation had been an exploratory laminectomy. The blood culture remained positive for weeks after the pneumonia subsided.

3. *Pneumococcus agglutination.* This test depends upon the development in the serum of the individual suffering from postoperative pneumonia of specific agglutinins, which will act upon the organism recovered from the pre-operative or postoperative sputum, or both, causing agglutination. The reaction is quite specific and its presence shows that the patient has developed a reaction against the organism. The only organisms agglutinated by this test were pneumococcus group IV and pneumococcus group II (atypical). This atypical group II is said to be closely allied to the group IV. The test is seldom positive at the beginning of the disease, but if it be repeated at three day intervals, three or four times, it will become positive, usually with the third or fourth tests, i.e., the ninth or twelfth day, if the patient develops the reaction at all. This probably indicates the length of time during which the individual is acquiring his agglutinins. When pneumococcus group IV, recovered in the postoperative sputum, is of a different strain from that in the pre-operative sputum, if the serum develops the power of agglutination, it will be specific for either one strain or the other, but not for both. The agglutination test was performed in forty-two cases of postoperative pneumonia with positive results in about 24 per cent. None of the embolic pneumonias showed a positive agglutination. Table VIII shows relation of sputum to agglutination and time required for reaction to develop.

4. *Urine precipitin test.* This is probably an equally specific test depending upon the precipitation by a protein in the urine of the organism recovered in the pre-operative or

TABLE IX

Hospital	No. of Cases	Pneumonia Morbidity	Morbidity Percentage	Mortality	Mortality Percentage	Mortality Per Cent of Morbidity
Mayo (Beckman) 1910 (3)	3657	10	0.27	5	0.14	50.0
Mayo (Beckman) 1912 (4)	5835	19	0.32	6	.10	31.5
Mayo (Beckman) 1913 (5)	6825	27	0.39	0	0.0	0.0
Roosevelt Hospital, N. Y., (L. S. B.) (6)	2612	23	0.9	7	0.26	30.4
New York Hospital, F. W. B. (7)	1413	15	1.06	7	0.50	46.6
Mass. General, E. C. C. L. J. J. M	3490	40	1.14	22	0.63	55.
Montreal General, Armstrong (9)	2500	30	1.20	22	0.88	73.3
Leipzig Laeven (8)	9755	180	1.8	113	1.15	63.
Presbyterian, A. O. W. 1915–16	3719	97	2.1	25	0.66	25.7
Presbyterian, M. C.	1940	65	3.3	7	0.36	10.7

postoperative sputum. This test has only been tried during the last four of the twelve months during which this series runs. It was positive in five out of sixteen cases which is a somewhat higher percentage than the agglutination test. In one case in which the bacillus mucosus capsulatus was recovered in both pre-operative and postoperative sputum, the test was positive for pneumococcus group I, showing that although the sputum failed to demonstrate it, there must have been a group I infection. When the pre-operative and postoperative pneumococci were of different strains of the same group, the precipitation held for one strain only.

The result of the bacteriological investigation has been to establish the specificity of the causative organism in 18 out of 58 cases of postoperative pneumonias. In eleven of these the pneumococcus group IV was the causative organism. During the disease this organism was isolated from the sputum twice as frequently as all the other organisms combined. There can be but little doubt but that the pneumococcus group IV is in most instances the cause of that definite and distinct type of pneumonia already described and called in this instance, postoperative pneumonitis. The bacteriology of the embolic pneumonias presents a different aspect. In one instance the positive blood culture may be the cause of the pneumonia by a bacterial embolus. The pneumonia may possibly in another instance be the result of a secondary infection of an embolus already present in the lungs. The pneumococcus group IV was however, found most frequently in the sputum of pneumonias of this type as well as in that of the postoperative pneumonitis.

MORTALITY

In considering the mortality in postoperative pneumonia, attention should be paid to whether or not the patient died as a result of his pneumonia. There were seven deaths in the sixty-five patients, making the mortality 10.7 per cent. No one of these occurred where the pneumonia was the only complication, in other words no otherwise healthy patient undergoing operation died as a result of his pneumonia. Malignancy claimed three patients, one with carcinoma of the colon, another with carcinoma of the œsophagus and a third with carcinoma of the cystic duct. All of these were in very poor condition. A pulmonary embolus caused one death. Another patient died in a diabetic coma following incision and drainage of an alveolar abscess. A mastectomy in a patient sixty-five years of age, not in very good condition, resulted in a fatal pneumonia. The seventh patient died of inanition following a duodenal fistula rather than from the pneumonia. It is only fair to say that two other patients in the present series died in the hospital; one, a paraplegia with a positive blood culture, died of sepsis six weeks after the embolic pneumonia had subsided, the other died over a month after his pneumonia and from no associated condition. One of the most distressing tragedies of hospital experience is to see a young, healthy individual undergo a simple surgical operation and die of postoperative pneumonia. During the past year, we have fortunately been spared this, perhaps due to greater care in prophylaxis.

For the greater part of Table IX, the writed is indebted to Cutler and Morton.

The Presbyterian Hospital statistics have simply been added. As the above mentioned investigators have pointed out the statistics from the Mayo clinic can in no way be compared to those of a general city hospital, because their patients must be fit to stand railway journeys of varying distances. The low morbidity of this clinic is quite remarkable. Although the morbidity of postoperative pneumonia at the Presbyterian Hospital has been increasing during the past three years, the mortality percentage has been falling even more markedly. The present series shows the highest morbidity percentage in Table IX, but it shows also by far the lowest mortality percentage of morbidity. This leads to the question whether at the other clinics there might not have been other postoperative pneumonias not altogether frank clinically, which roentgenography and bacteriological investigations might have revealed.

TREATMENT AND PROPHYLAXIS

The following prophylactic measures have been instituted and followed out with considerable faithfulness during the past year.

1. Great care is taken to elicit a history of recent cold, cough, sore throat, etc., and in the physical examination the respiratory tract is given special attention. Patients with history of recent cough or signs of rhinitis, tonsillitis, pharyngitis, etc., are sent home to wait a week or two if their operation be one of choice.

2. In case of operations of necessity in patients with signs of inflammation of the respiratory tract, ether is seldom used, if it can be avoided. Chloroform, gas and oxygen, and local anæsthesia have been used with such patients whenever possible.

With the experience gained from Whipple's work on the problem, the following measures for prophylaxis were put in the form of rules for the nurses to observe:

1. The temperature of the bathroom for the routine admission bath must be 70° F.

2. No patient who has had his admission bath and is to be operated on the following day shall be allowed out of bed.

3. The hair of all female patients is to be thoroughly dried with an electric blower.

4. Before leaving operating room each patient shall be given a dry, warm night shirt and be carefully covered with sufficient blankets.

5. On arriving in the ward, a cotton pneumonia jacket shall be put on each patient.

6. Sufficient blankets must be provided and all draughts avoided.

7. As soon as the patient is conscious, a heavy woolen bed jacket is to be worn.

(The rules relating to blankets, bed jackets, etc., did not apply during hot weather.)

Two additional experiments in prophylaxis were tried:

1. All the patients of one male ward were given tincture of digitalis, 15 minims on admission and every four hours until they had 40 minims in an attempt to obtain a digitalis effect on the heart to combat pulmonary congestion during the operation.

2. All patients of another male ward had their chests rubbed with a turpentine camphor liniment immediately after operation.

Of these two measures the counter irritation seemed to be of some benefit and came into pretty general use throughout the hospital in cases where any respiratory trouble was anticipated after operation.

The treatment of postoperative pneumonia is almost entirely symptomatic. If it should be due to pneumococcus group I, serum is to be used. Fresh air by an open window and forced fluids were almost invariably used. Digitalis was used in 38 cases out of the 65, usually in the form of the tincture, though occasionally digipuratum or digalin was given intravenously. On rare occasions camphor or caffeine was given, but when such stimulation was indicated it was of doubtful benefit.

CONCLUSIONS

1. Coughs, colds, and other inflammatory conditions of the respiratory tract are the most important factors predisposing to postoperative pneumonia. Restriction of abdominal respiratory movements as a result of incision, postoperative distention, tight dressings, is also a definite factor.

2. Exposure of the patients to cold while in the hospital before, as well as after, operation, is responsible for a certain number of postoperative pneumonias.

3. The pneumococcus group IV is most frequently the inciting organism of postoperative pneumonia.

4. The urine of patients suffering from postoperative pneumonia frequently develops precipitins against the organism recovered in the pre- or postoperative sputum, while the blood develops agglutinins.

5. The pneumonia due to pneumococcus group IV is a definite clinical entity, differing from the pneumonia due to pneumococcus groups I, II or III.

6. The use of the roentgenogram in all cases of suspected postoperative pneumonia and the careful and constant search for physical signs will reveal more postoperative pneumonias than have hitherto been reported.

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HYDATIFORM DEGENERATION IN TUBAL PREGNANCY

A Report of Forty-Eight New Cases

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STRANGELY enough, the occurrence of chorio-epithelioma arising from tubal pregnancy seems to be better known and also better established than the occurrence of hydatiform mole within the tube. This is especially surprising in view of the stress laid especially by Marchand (1895) upon epithelial proliferation in cases of hydatiform mole, and in view of the fact that trophoblast formation and epithelial proliferation in general have been regarded as being greater in tubal than in cases of uterine implantation. This is illustrated well by such cases as that of Fellner (1903) in which it was found impossible to distinguish by histologic examination between the epithelial proliferation present in a case of tubal pregnancy and that from a chorio-epithelioma. It seems to me that from these circumstances alone one might expect hydatiform degeneration to be relatively more common in the tubes. Moreover, when it is recalled that experts still regard it as impossible to decide the question of malignancy or benignity in cases of suspected uterine chorio-epithelioma on the basis of histologic preparations alone, this surmise gains more in probability. The presence of hyperactivity in the trophoblast in many cases of tubal pregnancy as compared with the uterine, was confirmed also by personal observation, and if, as stated by Teacher (1903), chorio-epitheliomata arose from hydatiform moles in approximately 40 per cent of 287 cases, and according to Seitz (1904) and Frankel (1910) in 50 per cent even, the occurrence of hydatiform degeneration in tubal pregnancies can hardly be doubted because of this fact alone. Nevertheless, of the 7 cases of tubal hydatiform moles cited by him, Werth (1904) regards only the case reported separately by von Recklinghausen (1889) and by Freund (1889) as well authenticated. Werth reserves judgment, however, on the case of Matwejew and Sykow (1902), a report upon which was accessible to him, and to me, in a short review only. Seitz, however, accepted the short review of this case as convincing, nor questioned the case of Otto (1871), or that of Wenzel (1893) but incorrectly credits Wenzel with 2 cases. Werth, on the contrary, regarded these last 2 cases, and also that of

Croom (1889), which is accepted also by Veit (1910) as genuine, as undoubted instances of "simple hydropic degeneration of the connective tissue of the villi so common in aborted chorionic vesicles, both from the tubes and from the uterus." But Werth unfortunately does not state just what he means by simple hydropic degeneration. Since he speaks of it as common in aborted ova, one may conclude that he refers to changes in the chorionic vesicle while still within the uterus, after its complete detachment from its implantation site. For want of a better term such changes may, I presume, be spoken of as maceration changes, although they may not occur under sterile conditions. However, I do not thereby imply that these changes are similar under sterile and under putrefactive conditions. They undoubtedly differ.

Since Werth speaks of simple hydropic degeneration in aborated ova, he does not, I take it, refer to a dropsical condition of the villi possibly due to an obstruction of the venous return, for such a condition necessarily would be rare and not common. Moreover, this condition of necessity would have to arise before and not after the death of the embryo and of detachment of the chorionic vesicle. As in one of the cases of Hiess (1914), such a specimen also should contain blood-vessels, for as emphasized also by Ballantyne (1913) the hydatiform villus not merely is an œdematous villus.

That any one at all familiar with hydatiform degeneration in its earlier, as well as its later forms, could upon gross and microscopic examination, confuse such a condition with maceration changes in a fairly well-preserved specimen in any but its very earliest or very latest stages does not seem possible to me. Normal villi contain capillaries, not to mention other things characteristic of them. Hydatiform villi, on the contrary, do not contain them or only very rarely so and in early stages. When a villus becomes hydatiform, that is, when liquefaction of the stroma occurs, this liquefaction appears in more or less restricted portions of the villus, thus giving rise to the long fusiform, and later spherical vesicles so characteristic of the hydatiform mole. But when a villus becomes macerated the change is general, and usually also is noticeable in the embryo and in the chorionic membrane itself, or at least within its epithelium. The latter usually is lifted from the stroma here and there, the caliber of the entire villus is increased and the capillaries and the stroma also show maceration changes as the villus becomes more translucent. This increase in caliber of the entire villus is not due merely to local liquefaction of the stroma, but to the pseudo-œdema occurring under such conditions, in a villus of normal structure and form. In hydatiform moles, on the contrary, the epithelium not only is firmly attached but usually is hyperactive. The changes characteristic of hydatiform degeneration may and often do appear in the villi while they still are implanted, and do not arise only after the chorionic vesicles are detached. This does not imply, however, that the villi of a detached hydatiform mole cannot also undergo maceration changes. They, of course, frequently do so, and it is in such cases as these that differentiation may be difficult or impossible, especially if differentiation is to be made from an examination of ill-preserved fragments only. The same thing is true also of the villi in the early stages of hydatiform degeneration and maceration, when the latter masks the former. The difficulty in diagnosis would be still greater in case of whole chorionic vesicles which are almost completely dissolved, leaving only a shadow picture formed by coagulum without nuclei, which nevertheless may retain the form of the chorionic vesicle and of the individual villi almost perfectly. Such cases as these it long may be impossible to differentiate, but they form only a relatively small proportion of the whole. The many cases both of uterine and of tubal chorionic vesicles which still were implanted and showed exceedingly fine instances of hydatiform degeneration, as well as the many splendid examples of groups of villi detached from the chorionic vesicle, which still were implanted in the tube or in the decidua, and which were equally good examples of hydatiform degeneration, leave no room for doubt as to the frequency of occurrence of this condi-

tion, even after due allowance for the occurrence of doubtful cases is made.

Werth further concluded that not one of the seven cases of chorio-epithelioma regarded as having arisen from tubal pregnancies recorded before 1904, was sufficiently authenticated. Nevertheless, by 1908 Veit felt justified in saying that a considerable number of cases of chorio-epithelioma arising from tubal pregnancies had been described. Veit added that Risel (1905) gathered 11 cases from the literature, and that a second case had been reported since Risel's paper.

Since my interest in this subject is largely incidental, I have not taken the trouble to gather from the literature cases of chorio-epithelioma alleged to have arisen from tubal pregnancies which may have been reported since Veit wrote. Moreover, I could not presume to judge these cases critically. Hence I will accept the fact that chorio-epithelioma arising from tubal pregnancy is regarded as established by a number of investigators and if the present conception regarding the relation of chorio-epithelioma to hydatiform mole is justified, then the occurrence of hydatiform degeneration in tubal pregnancy must follow on *a priori* grounds alone. Moreover, whatever the causes of hydatiform degeneration may be, one probably is safe in assuming that the condition is not restricted to the uterus, and when I noticed that hydatiform degeneration was so very common in young uterine abortuses, the surmise that it might be still more common in cases of tubal pregnancy seemed justified. Since over 100 specimens of tubal pregnancies from the Mall collection were included in the survey originally planned by Mall, a study of these specimens formed an excellent opportunity for observations on this subject.

That the case of tubal pregnancy of Otto, with its pathetic history, really was one of hydatiform mole, one cannot doubt in view of the careful description of the whole case, its clinical history, necropsy and the histologic examination. This case is interesting also because the degeneration was in its early stages, the hydatids being only as large as a pinhead, and the embryo still being present. Moreover, from Otto's description it is very likely that the specimen contained Hofbauer cells which are discussed elsewhere (Meyer, 1919).

The history of the case observed by Wenzel in 1855 and reported in 1893 is equally complete, and equally pathetic, as can be surmised by all familiar with the history of tubal pregnancy. In this case the mole was as large as a "hen's egg," the hydatids varied in size from a dot to a "bird cherry" wild (?) cherry, and the degeneration was universal, although the menstrual age of this specimen was given as only 51 days. It is significant that Wenzel expresses surprise that even excellent handbooks of the day had nothing to say about hydatiform mole in cases of tubal pregnancy, except perhaps to refer to the case of Otto. Nor does the case of Wenzel seem to be the first one observed, or that of Otto the first one reported, for Storch (1878) in truly epochal, though largely ignored observations on hydatiform mole, states that Hennig (1876) stated that 2 cases of moles in the tube were reported by Blasius (very likely E. Blasius, 1802–75). Since Storch wrote on hydatiform mole it is implied that Blasius saw such and not another type of mole, and since hydatiform mole is such a striking condition and has evoked much more interest than the other forms, an observation regarding it in the tubes, well might travel down the decades, especially since until recently, the occurrence of hydatiform degeneration in the tubes was regarded as extremely rare. This is indicated also by the fact that Menu (1899) still referred to the case of Otto as a curiosity.

Pazzi (1908) states that 2 cases of extra-uterine moles have been described each by Hennig (1872), Favell (1893), Donald (1902), and one case each by Otto, Freund, Theilaber, Maret, Matwjew (Matwejew?) and Sycow, Bland Sutton, and one case of ovarian mole by Wenzel (1893). Wilkinson is said to have described a case of rupture of the tube with reduction of the mole to the size of a cherry, and Lob (1902) a case of molar tubal pregnancy without cessation of menstruation. Since I am quoting Pazzi essentially verbatim, it is evident that he did not read the

literature critically or discriminate between ordinary and hydatiform moles, but was misled by the old inclusive usage of the terms mole and molar still current at the present day.

Krueger (1909) also reported a case of hydatiform mole with a cyst as large as a "walnut." The pedicle of the cyst was 4 centimeters long and attached to the amnion near the cord. Krueger spoke of this as a placental cyst, but regarded it as a hydatiform-mole-like structure which microscopically was limited to a single villus. If this were the only evidence presented by Kreuger one well might question the nature of this cyst, but he added that microscopically the beginnings of hydatiform formations could be recognized on other villi also. Hence it would seem that Kreuger's cases must be added to the authenticated cases of hydatiform degeneration in the tubes.

So far as I am able to learn we have, then, in the literature, reports of 8 cases of hydatiform mole occurring in the tube. Of these, 2 or 3 cases are not well authenticated, however. These 8 cases consist of the 2 cases of Blasius or Hennig, that of Otto, of von Recklinghausen and Freund, of Wenzel, of Croom,' that of Matwejew and Sykow, and that of Krueger. A critical reading of Hennig's (1876) book on diseases of the tubes and tubal pregnancy makes it quite clear, however, that Hennig merely said that Blasius discovered "tubal moles" and that he observed 2, and Behm 1 case of abortion of tubal moles. From the context it also is very clear that Hennig was not discussing hydatiform moles, although it is not possible to say whether he meant that he himself or Blasius observed 2 cases. I should judge that the latter is the idea it was meant to convey. To the 6 remaining cases I make bold to add that of Maxwell (1910). In reading Maxwell's description one cannot help but feel that he himself regarded the case as one of hydatiform mole, but that he deferred to the opinion of the "committee." This is also suggested by the title of his article. The illustration which accompanies Maxwell's article is so very suggestive, and his description so characteristic of hydatiform mole that it seems very probable indeed that the specimen really was such. Maxwell states, for example, that "sections of the villi embedded in the wall of the tube have the typical structureless, bloated appearance of such pathological villi; and though there is no central cavitation in the villi, their structure, associated with the active proliferation of the Langhans' layer, suggests that one is looking at a stage just short of vesicle formation." Moreover, as I am about to show, hydatiform mole is so very common both in tubal pregnancies and in uterine abortions that the likelihood that Maxwell's case actually was one of hydatiform mole is increased still further. This, to be sure, merely is a presumption, and a more complete description, or an examination of the specimen itself only could decide the matter.

In connection with what has been said, it is interesting that Maxwell also emphasized that epiblastic activity is increased in all abnormal sites of implantation, and any one interested in the problems of tubal pregnancy and acquainted with Mall's (1915) findings will be struck by Maxwell's statement "that microscopic examination of many cases of tubal gestation lends no weight to the view that chronic inflammation of the tubes is at all a common causal factor." Nor can I refrain in this connection from quoting the strangely uncontradicted opinion of Doran, expressed in the disscusion of Maxwell's case, that tubal gestation "probably represents some general deterioration in the generative power among civilized women."

To these 7 cases contained in the literature, I wish to add 48 found among the first 1187 accessions from the Mall collection. Nor is it necessary to stop with these, for the rest of this collection contains others not here included. It is merely a matter of recognizing the specimens by a routine examination, and since this paper has been written, a number of specimens have been recognized among the daily accessions of tubes which we receive through the unselfish efforts and the scientific interest of practitioners, from all parts of the nation.

In addition to over 100 specimens of hydatiform degeneration reported elsewhere,

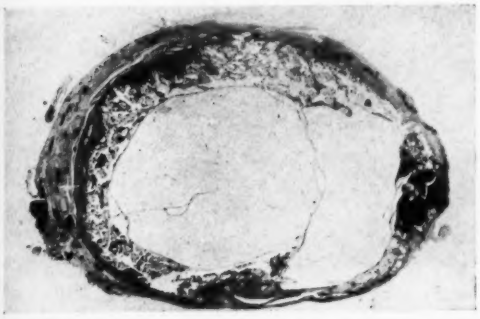

Fig. 1. Cross section of a hydatiform, twin, tubal pregnancy. No. 825, case of Cecil E. Vest. No embryo.

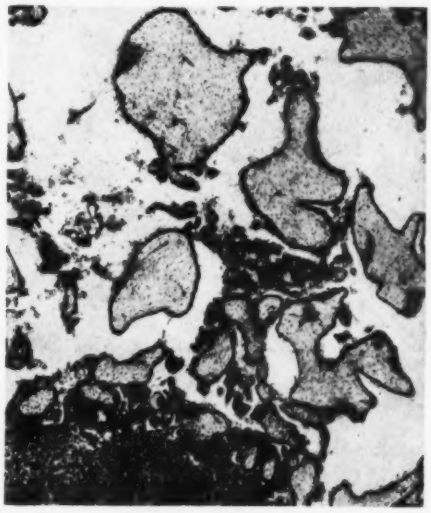

Fig. 2. Hydatiform villi from same case as in Fig. 1.

I also have seen more than a dozen fine specimens in large sections of uterine implantation sites, and also a number of entire specimens still embedded in the pregnant uteri and tubes. Indeed, how many cases of hydatiform degeneration one can find in abortuses in tubal or hysterectomy specimens even, will depend very much upon the care with which the examination is made, for the condition undoubtedly is extremely *common*, and not rare, as heretofore supposed.

Although the alleged menstrual age of these 48 conceptuses ranged approximately from 6 to 218 days, most of them were young *empty* chorionic vesicles or mere remnants of such. Portions of quite a number still were implanted within the tube, however, and among these were two unusually fine specimens from a twin pregnancy in the tube donated by my friend, Cecil E. Vest of Baltimore. Since the question of superfœtation has been raised also in connection with twin tubal pregnancies, I hasten to add that such a phenomenon, even if it ever occurs, which seems exceedingly doubtful, can be excluded absolutely in this case. Both chorionic vesicles were approximately of the same size and lay in practically the same cross section of the tube, the surfaces of contact being flattened.

Before proceeding with the statistical findings I may say that the abortuses in the Mall collection, which are regarded as pathologic, are grouped (1) as villi only; (2) as empty or partial chorionic vesicles; (3) as chorionic vesicles containing some or all of the amnion; and (4) specimens containing a nodular; or (5), cylindrical embryo, or (6) a stunted, and (7) macerated and mummified fœtus. Any one interested in this classification will find it discussed and exemplified in an article by Mall (1917), and also in a forthcoming publication by Mall and Meyer, to be issued by the Carnegie Institution of Washington.

There were 34 tubes containing villi only, and in 13 of these hydatiform degeneration probably was present. In 8 specimens its presence was undoubted, but in 5 it was probable only. I realize that this margin of probability is exceedingly large, but if it is recalled that often only a few degenerate villi embedded in clot were contained in the cross sections of many of the tubes, and that only a few sections, and not, of course, a complete series of each tube, were examined, this is easily understood. Had the entire tubes been examined, or if more villi had been present, and if those present had been better preserved, the difficulty would have been obviated almost wholly. However, it is idle to set forth these things, because such conditions never will obtain, and if it be remembered that a large series of specimens necessarily supplement each other, the margin of

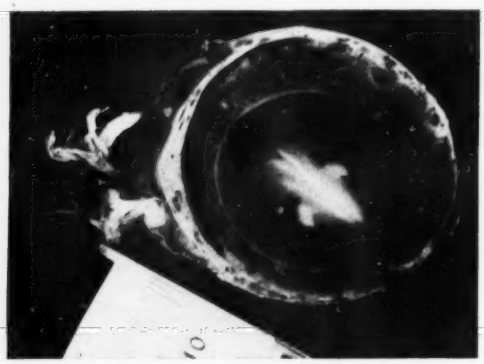

Fig. 3. Cross section of a hydatiform, tubal pregnancy with embryo. No. 1771, case of H. M. N. Wynne.

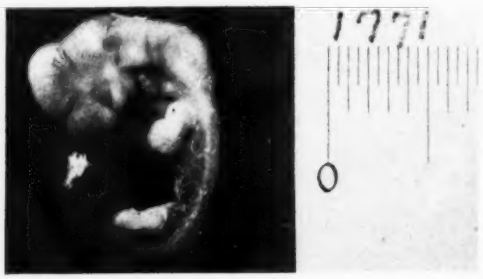

Fig. 4. Embryo from same case showing magma.

probability becomes greatly reduced. Moreover, the changes in the villi often are so typical that they are unmistakable, even if only a few villi are present. Besides examination in complete series undoubtedly would increase, not decrease, the number found. In some of the doubtful cases the existence of hydatiform degeneration became probable only upon comparison with the many uterine specimens previously examined.

The evidence offered by the 34 specimens in the second group which is composed of empty chorionic vesicles or parts thereof, was very conclusive, for the cut portions of most of these tubes contained considerable portions, or even sections of whole chorionic vesicles, sometimes quite free from clot. Some of these were implanted almost perfectly in the wall of the tube, and although many of them were folded extremely and were collapsed more or less, small areas of several, nevertheless, were implanted undisturbed within the tube. The villi in some of these implanted specimens were so characteristic, and the whole picture was so exquisite, that these specimens rightly belong among the very finest instances of hydatiform degeneration found so far. Many of the tubal specimens were remarkable indeed, and this is true in particular of the case of twin pregnancy received from Dr. Vest. In this specimen the two chorionic vesicles, the intervillous spaces of which were devoid of blood, lay in almost the same transverse diameter of the tube, and hence had distended the latter considerably. Both were implanted quite well over the entire area of contact, which included the whole perimeter of the tube. The chorionic vesicles were flattened at the region of mutual contact which divided the tube somewhat unequally, as shown in Figure 1. Although the embryo and the amnion long had disintegrated completely, and although the chorionic membrane itself is thin, covered by degenerate epithelium and also disintegrating, the epithelium of the villi not only is well-preserved but is accompanied by large masses of trophoblast and considerable syncytium as shown in Figure 2. Syncytial buds are found on the chorionic membrane also. The tubal mucosa is largely, and the tubal wall partly, destroyed by the invading trophoblast. Only a few small vestiges of the walls of the villous vessels remain, and the stroma of all of the villi has undergone changes characteristic of hydatiform degeneration. One villus also contains an epithelial cyst resulting from epithelial invagination with subsequent isolation of the distal extremity, a process to be referred to elsewhere (Meyer, 1919) in connection with uterine specimens. Since most of the villi of this and similar specimens still are implanted in the tube, there no longer can be any question as to the time in which hydatiform changes in the stroma of the villi are inaugurated. As illustrated in previous instances in which isolated and small groups of villi still were implanted, the advent of degeneration of the stroma occurs, in part at least, before the villus is detached. It not merely is a maceration change.

Another very interesting specimen of tubal implantation is No. 1771 received from H. M. N. Wynne of the Johns Hopkins Hospital and shown in Figure 3. The menstrual age of this specimen is 49 days, but its anatomic age, as based on length, according to Dr. Streeter's curve (unpublished), is 37 days, thus showing a discrepancy between the menstrual and anatomic ages of 12 days. The embryonic length is only 12.5, although with a menstrual age of 49 days it should be at least 18 millimeters. Upon examination, Dr. Streeter found the chorionic vesicle to contain a good deal of magma, some of which still was adherent to the embryo, as Figure 4 shows. As has been repeatedly emphasized in the literature, the presence of this coagulum in itself probably indicates that the embryo died some time prepartum.

The wall of the tube was quite thin, as Figure 5 shows, but the implantation is fairly well preserved around the whole perimeter of the specimen. The mucosa is destroyed throughout the greater extent of the section, but the trophoblast is abundant except in one rather degenerate and hæmorrhagic area. The chorionic membrane is thin but contains some vessels distended with blood. The stroma of many of the villi also contains vessels filled with blood, but the vessels in many villi are very evidently in degeneration. The syncytium is scanty, and many of the villi are very plainly hydatiform, as Figure 6 shows.

A second exceptionally fine specimen of tubal hydatiform mole is No. 2052, donated by N. M. Davis of Washington. Figure 7 shows a portion of the tube containing the hydatiform mole, some hydatiform villi of which protrude through an incision in the wall of the tube. The whole opening is filled with typical hydatiform villi which are perfectly evident to the unaided eye, and very evident under an enlargement of 4 diameters. They present an extremely fine picture when seen with the binocular under a magnification of 10 to 20 diameters. Examination under a higher magnification shows that the preservation of the specimen is unusually good, and that all the villi are markedly hydatiform. Trophoblastic proliferation is so marked that

Fig. 5. Cross section of tube.

in some places it gives the appearance of decidual formation. Relatively little syncytium is present, but the trophoblast invades the muscularis in many places, and a good deal of coagulum is present, most of it apparently having arisen from degeneration changes in the stroma of the mucosa, and from similar changes in the trophoblast and the muscularis. The latter is moderately invaded by round cells. No remnant of the wall of the chorionic vesicle or of the amnion or embryo could be detected in the sections examined, both evidently having been absorbed completely and only some of the villi remain behind. Or, the chorionic vesicle may have been aborted and these villi left implanted within the tube.

Some exceedingly fine hydatiform villous trees were found among the specimens in this group. Scaffoldings or frameworks formed by proliferating syncytium arising from the epithelium of the chorionic membrane also were seen. Since the syncytial buds also were found far out on proliferations of trophoblast which capped the villi, and also in the center of trophoblastic nodules, the origin of the syncytium from the Langhans' layer would seem to be again and exceptionally well confirmed here. In some cases a detached

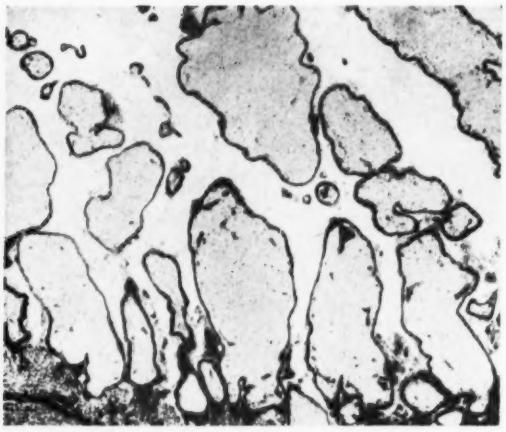

Fig. 6. Hydatiform villi from the same case.

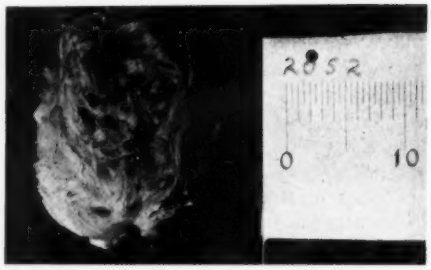

Fig. 7. Excised portions of a pregnant tube showing hydatiform villi protruding from the incision. No. 2052, case of N. M. Davis.

hydatiform villus was fastened by opposite extremities to two portions of the tube wall. It is well to remember, however, that these attachments may have been gained, and indeed they probably were gained before the separation of the particular villus from the chorionic vesicle.

Of the 34 cases remaining in this group of chorionic vesicles without amnion 17, or 50 per cent, showed the presence of undoubted hydatiform degeneration, and in one additional case its existence was doubtful.

Since only a few specimens are contained in each of the last five groups, I shall treat them as one. Among the 30 specimens in these groups, 16, or 52.3 per cent, showed the presence of hydatiform degeneration. From this percentage it is evident that the incidence of hydatiform degeneration among tubal specimens seems to increase slightly with advancing age of the conceptus rather than decrease, as was emphasized in connection with the uterine specimens considered elsewhere. (Meyer, 1918.) This probably can be attributed to the fact that the specimens in the first group are composed of villi only, and that many of the empty chorionic vesicles in group 2 were detached from the wall of the tube by hæmorrhage, before hydatiform degeneration had developed sufficiently to enable me to recognize it. Moreover, it must be remembered that all tubal specimens, no matter in what group they are classified, are in fact young specimens and since those falling in the later groups succeeded in maintaining a foothold in spite of repeated hæmorrhages, a larger number of them might rightly be expected to show the presence of a hydatiform change.

The incidence of hydatiform degeneration among 104 tubal pregnancies classed as pathologic is 48, or 46.1 per cent of the whole. This is a somewhat higher incidence than was obtained in the 348 uterine abortuses classed as pathologic. This may be due partly, or wholly even, to the greater incidence of young specimens in the tubal series. That the tubal specimens undoubtedly were younger follows from common knowledge regarding tubal pregnancies, but it also is shown by the average menstrual ages, which were 43.4 days in 25 tubal, as compared with 66.6 days in 51 uterine specimens. Moreover, 32 of the 48 tubal specimens of hydatiform degeneration, or 66⅔ per cent, fall into the first two groups of the pathologic, thus again showing that the majority are small, young specimens.

Although the incidence of hydatiform degeneration among the pathologic tubal specimens is but slightly higher than that among the pathologic uterine specimens, the incidence of hydatiform degeneration in all tubal specimens, both the normal and pathologic, is twice as high as that among the same classes of uterine specimens. This difference can be explained only partly by the fact that a larger proportion of the tubal specimens are young and pathologic. The pathologic tubal

specimens were found to form 62.9 per cent of 153 normal and pathologic tubal specimens found among the first 1187 accessions, but the pathologic uterine specimens form only 33.6 per cent of the normal and pathologic uterine groups among the first 1187 accessions. Hence the real question remains, for the incidence of hydatiform degeneration among the specimens classed as pathologic was essentially the same in tube and uterus. The increased incidence of hydatiform degeneration, of 100 per cent in all tubal as compared with all uterine specimens may be due to the less favorable nidus found in the tube. If so, it throws a very significant light upon the probable cause of hydatiform degeneration, which would seem to lie in the conditions surrounding implantation and early development rather than in the ova or spermatozoa themselves.

Whether hydatiform degeneration in the tube also is relatively more common near the menopause as was found to be the case in uterine pregnancies I do not know, for I have not been able to obtain data on the relative frequency of tubal pregnancy in the different decades of the reproductive life of women. However, since by far the greater number of uterine pregnancies occur early in this period, it probably would be safe to assume that most tubal pregnancies also occur during this time. Consequently it might well follow that the ratio of tubal hydatiform degeneration to the number of tubal pregnancies occurring in the *later*, actually might be greater than in the *earlier* decades.

The conclusion reached in a study of uterine specimens that hydatiform degeneration is *absolutely* less, not more frequent near the menopause, is confirmed also by the study of the tubal specimens. The average age of 20 women in the tubal series was 33.9 years, as opposed to an average of 31 years obtained from 36 women in the uterine group. This age difference offers a tempting opportunity for generalization, and did the statistics include thousands of cases one might be willing to say that it points to a progressive change as cause, which begins in the uterus and finally reaches the tubes. But strangely enough, the average number of years of married life of 15 women in the tubal series is exactly the same as that of 29 women in the uterine series, or 7.1 years. This fact at once guards against a venturesome hypothesis, for it allows a no longer period for the supposed ascending change to reach the tubes than the uterus.

Eight of the 20 women in the tubal series had borne one child, four had borne two, and three more than two; thus again more than confirming the statistical findings in the uterine series, which show that 9 of 33 women had borne once and 18 twice. The parallelism between these statistics is striking indeed, especially if the numbers involved be considered. Fourteen of the 23 women, or 60.8 per cent, in the tubal series had aborted but once, as compared to 19 out of 44, or 46.3 per cent in the uterine series, facts which again point to the middle, rather than to the end of the reproductive life of these women.

Since the structural changes in hydatiform degeneration will be considered more fully in the Mall Memorial Volume, I shall not repeat the description here. Suffice it to say that since I directed my attention especially to hydatiform degeneration I have been able to recognize its presence repeatedly at sight in relatively young chorionic vesicles —one centimeter large—not only from uterine but also from tubal pregnancies. This is true, of course, especially in the former, for the chorionic vesicles of these often are quite characteristic, and when inspection with the unaided eye or with a reading glass under a magnification of two diameters, fails to reveal the true nature of the specimen, examination with a binocular under a magnification of ten or twenty diameters often does so at sight.

The observations reported here should not in themselves be permitted to change the present opinion regarding the malignancy of uterine hydatiform mole. That opinion is based on specimens which survive until the later months of pregnancy, and the tendency to malignancy in such may be and undoubtedly is, a totally different one from that present in the overwhelming majority of specimens which are aborted in the early

months of pregnancy. The great frequency of hydatiform degeneration in uterine abortions first emphatically asserted by Gierse (1847) and confirmed with some qualification elsewhere should, however, counsel every practitioner to be on the alert, especially in cases of uterine abortion.

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IMMEDIATE SURGICAL MANAGEMENT OF ACUTE APPENDICITIS IN MILITARY HOSPITALS

Suggesting a Possible Relationship Between the Onset of This Condition in Those Cases with a History of Previous Attacks and the Present Method of Administering the Triple Typhoid Vaccine

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ANYONE who has listened to, and practised, the lessons taught by the late John B. Murphy in the surgical management of acute appendicitis cannot help but be profoundly impressed with the accuracy of his teaching, especially where opportunity affords an extensive observation over acute abdominal lesions.

This opportunity has come to us in the surgical management of 248 cases of appendicitis operated on at the Camp Pike Base Hospital. The following pathological conditions of the appendix were found:

Acute cases		143
a. Not ruptured	122	
b. Ruptured	15	
c. Necrotic	6	
Subacute cases		36
Chronic cases		65
Appendicitis obliterans		4
		248

The feature of paramount importance in the early recognition of acute appendicitis is brought out by a carefully and intelligently interrogated history. Conviction in the necessity of instituting surgical treatment within the first few hours after the onset of acute appendicitis prompts me to urge the taking of a more methodical history, and the institution routinely of a searching examination in every abdominal condition in a patient seeking advice from a physician.

I am of the opinion that medical men do not frequently get out of the patient's history the points of real diagnostic value. Under a controlled system of examination and history taking, such as is required in this hospital, it is interesting to note how quickly and accurately young medical officers have been trained to recognize acute lesions of the abdomen.

I wish to digress at this stage of the discussion of the history of this disease to give an account of what has been done at this hospital to bring these cases under early surgical observation.

In the latter part of November, after an experience in handling a number of patients suffering with ruptured appendicitis and peritonitis because of delay in being sent to the Base Hospital, I asked permission of the Commanding Officer of the Hospital and the Division Surgeon, to take this subject up at the weekly lyceum meeting with the regimental surgeons. In this conference the mortality statistics were brought out where operation followed; (a) in the first 12 hours; (b) 36 hours (c) 72 hours, etc. etc. Vital importance was directed to the fact that where operation was performed for this disease in the first twelve hours after the onset, the mortality should be practically nil in the hands of a competent surgeon and in a hospital where modern surgical technique has been instituted.

The method of diagnosis was gone over in the detailed manner about to be given here-

Fig. 1. Photograph of Lieut. D's. appendix.

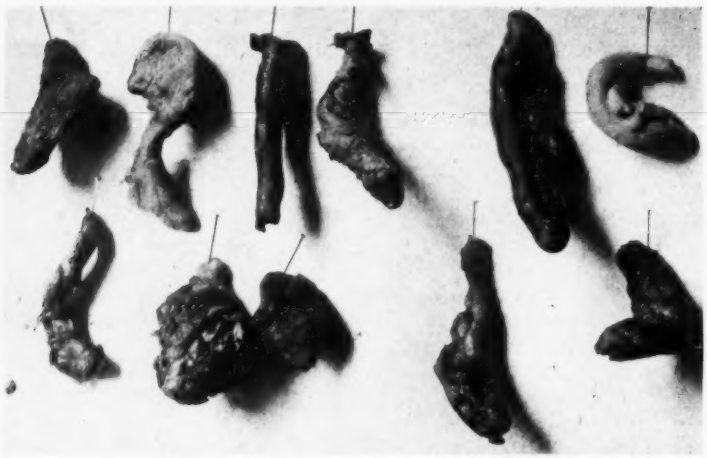

Fig. 2. Photograph of a number of appendices showing the pathological changes in this group of cases.

after in this paper. Much importance was attached to the fact that all cases suffering with pain in the abdomen should be sent to the hospital immediately even though the regimental surgeon did not make the diagnosis of appendicitis.

Since it is imperative that these medical officers not only keep the cardinal symptoms of acute appendicitis clearly before them, but also keep in mind their sequential order of occurrence, I am taking the liberty of reiterating them here.

1. Pain, cramp-like in character, the patient stating that the pain is in his stomach and not in the region of his appendix. The initial pain, complained of by the patient as in the pit of his stomach, finally becomes general and later is confined to the McBurney region. (It is very strange to me that so many medical men miss the significance of noting that the pain comes *first*, as many will state that the patient was sick at his stomach, when upon a close interrogation, the patient clearly states that the nausea came on later.) Muscular rigidity and local tenderness shows a marked contrast when compared with the opposite side.

2. Nausea or vomiting practically always follows and never precedes the abdominal pain. Since the nausea or vomiting may not come on for several hours to eighteen hours after the initial attack, the patient may have been operated upon before this symptom manifests itself. The nausea and vomiting, as a rule, is not repeated.

3. The increase in temperature is not of great significance, because it may or may not be present, though a slight increase at least is usually always present in these cases.

4. Leucocytosis, when it is positive, is a valuable symptom, and a differential count in order to show an increase of the polymorphonuclear leucocytes, should always be made.

I might take up much more time reviewing other symptoms or points of differential diagnosis, but will content myself with the review of these important cardinal symptoms that every medical man should keep constantly before him when he examines an acute abdominal condition.

Much interest has been manifested at this camp over the occurrence of acute appendicitis, characterized by some unusual symptoms, following inoculations of the triple typhoid vaccine. The clinical symptoms would seem to be milder than those observed in civil practice, among patients who have not been immunized against typhoid and paratyphoid fever. The blood findings have

been of special interest since even in many of the well-established inflammatory conditions of the appendix a leucocytosis apparently was not present. The blood findings were found so uniformly to contain a low white cell count in the presence of suppurative conditions of the appendix that it was decided to examine the blood of a few hundred soldiers in good health who had previously received the triple typhoid vaccine.

I have asked the Director of our Laboratory to make these examinations, and through the courtesy of Lieutenant Soloman F. Hoge, I am able to submit the following report:

This preliminary report which follows, includes the white blood count of two hundred persons of the Base Hospital. The first hundred was taken of the men on duty in the hospital and were considered perfectly healthy. The second hundred was taken from men who had been in the hospital for one or more ailments of a trivial character and just before a discharge from the hospital.

From the general condition of these patients, it seems that their leucocytic curves should stand about at its normal. These persons were chosen in an attempt to establish a measure of influence that the triple typhoid vaccine could show on the leucocyte curve of the individual and at the same time, if possible, to give some clue as to the question of why so many cases of appendicitis, acute and subacute do not show a higher leucocyte count.

The patients coming into the hospital to the Surgical Service for observation and for operation as the case may be, have all had at some time or other their triple typhoid vaccine. This course of immunization seems to be the one common factor which could possibly cause a transient or semi-permanent alteration in the leucocyte count. Not being able to find definite statistics in the literature at hand covering this point, it seems well to hold this uppermost in the course of our study. The technique employed was similar in every respect, and done by the same persons, as those who made the count for the operative cases. Each man was asked the time of his vaccination, whether one or more courses of vaccination, and the reaction that followed. Each person was questioned and examined for the possible condition that would cause an increase of leucocytes at the time of the count. The relationship to meals, the factor of excitement, depression, the presence and absence of malarial history were all considered, and where indicating a possible influence upon the leucocyte count, the patient was excused.

An inspection of the findings shows that the total leucocyte count of the first hundred men is 819,000, making an average of 8,198. The total months of the first hundred patients were 609, from the time of vaccination until the blood count. The average number of months was 6.09. The second hundred show a total count of 729,000, with an average count of 7,290. The total months from the time of vaccination were 533, with an average of 5.33. The chief differences in the comparison of those with a count between the various thousands, as shown by the table, shows in the first hundred "4" between the counts of four and five thousand, while in the second hundred the number is doubled. The first hundred of the series showed "7" between five and six thousand, while the second hundred of the series shows "18" between five and six thousand, otherwise the hundreds are similar, with the exception that the second hundred of a series shows "20," with a count of over 9000, while the first hundred of the series shows "35," with a count of over 9000.

Summing up the two hundreds, we find that the greatest number (43) is found between six and seven thousand. The next nearest number (41) is between seven and eight thousand. Adding these two, we find 84, or a percentage of 42, between six and eight thousand. The sum of those less than 7000, is 80, which gives us a percentage of 40, with a leucocyte count less than 7000.

A review of the blood findings submitted shows that 40 per cent of the bloods examined gave a white cell count of 7000 or under. In the event of these cases represented in this 40 per cent, i. e., those with a white cell count of 7000 or under, contracting an inflammatory condition, such as an acute appendicitis, it can be readily seen that a white blood count of 9 to 10 thousand would show a relative leucocytosis.

My observation over these cases leads me to believe that the foregoing is an explanation of a large number of the low blood findings in the cases of acute appendicitis developed at this camp.

Respecting a possible relationship between the inoculation of the triple typhoid vaccine and the onset of attacks of acute appendicitis, I have the following facts to submit. An examination and history (which is still going on) have been made of over fifty soldiers suffering with various inflammatory conditions of pyogenic origin. The following interrogations were made:

a. What was the date of the triple typhoid vaccination?

b. Did you have fever and malaise after the inoculation, and if so, was it sufficient to keep you in quarters or in bed?

c. Have you had bad teeth, bad tonsils, and does examination at this time show infections in the mouth or throat?

d. Have you had malaria?

Sufficient data have been collected to show that in a majority of cases a marked reaction follows the inoculations with the triple typhoid vaccine. Our examinations have covered a sufficient number of cases to say that it would appear that the reaction following the injection of the triple vaccine is a predisposing factor in the causation of an attack of appendicitis, particularly in those cases with a previous history of appendicitis. Whether this gives expression by the formation of an embolism from the vaccine itself or by causing the passage of an embolism from a point of focal infection into the end arteries of the appendix, or is responsible for a lymphadenitis that stirs up a latent infection in the lymph follicles of the appendix, cannot be stated definitely. However, the following evidence is suggestive of some pathological change in the lymphoid tissue of the body. An examination of many of the soldiers, giving severe reaction following the triple typhoid inoculations in addition to clinical manifestations involving the heart and kidneys, shows an acute adenopathy in various parts of their anatomy and a fair percentage manifests marked tenderness in the McBurney region.

It is thought that the lymph follicles of the appendix, may become a *locus minoris resistenciæ* and therefore, undergo an early inflammatory change in those soldiers suffering with infections about the teeth and mouth when the infection is stirred up and thrown into the blood stream by the vaccine reaction.

These references to triple typhoid vaccine are in no way to be construed as being opposed to immunizing against typhoid or paratyphoid fever as an experience of seven months' observation at this camp without a single case of either of these diseases is significant proof of how invaluable this prophylactic measure really is in military life. I am strongly of the opinion, though, that the triple typhoid vaccine should be given in five or six inoculations instead of three, as I am quite sure that the reaction would be much less, the patient spared from much unnecessary suffering and possibly from some complications.

We have operated upon a number of cases that were walking about in the wards and showing no signs of discomfort. In one case a soldier had been discharged with instructions to return to his barracks, when a slight distention of the abdomen called for reexamination, and one hour later an operation revealed a much distended, suppurative appendix.

In the early organization of this hospital these patients, as a rule, had had their initial symptoms of appendicitis in the regimental infirmaries or barracks, before entering the Base Hospital so that we had to depend upon the history given by the patient for a diagnosis, rather than upon the findings at the time of entrance into the hospital. The symptoms have been so mild in many cases that it has been difficult to impress the patient with the necessity of an immediate operation; so that in a number of instances, cases have gone on to a rupture before the patient consented to an operation.

I am of the belief that however slight the symptoms manifest themselves at the time of the patient's entrance to the hospital, the initial symptoms, though they may be mild, come in sequential order, and should permit the ward surgeon to make an early diagnosis when these symptoms are properly interpreted at the onset of the disease. It is singular that with the great amount that has been done and written regarding the subject of acute appendicitis, still so many medical men fail to grasp in their proper order the symptoms of this disease. The majority of cases reported in this paper, at the time they were examined by me, gave a history of the symptoms previously outlined in this paper, and though these symptoms were mild in degree, I believe, came according to the well-established law in appendicitis.

Among the early patients operated on, I wish to direct especial attention to the history of a young medical officer, because I believe it is fairly typical of many of our deceptive cases. Since this patient is a doctor, I am incorporating the history as given by

him. Let me say that even after a very careful and painstaking examination, it required considerable argument to persuade this officer that he was suffering with an acute appendicitis.

Patient, W. J. D., First Lieutenant, M.C., 312 Supply Train; born in Wilkesbarre, Pennsylvania; age 31; has always been healthy, never having suffered with any disease of consequence, except a mild attack of malaria, ten years ago. He has never had typhoid, and has always been free from constipation previous to this time. He received his inoculations of triple typhoid vaccine some time previous to this attack. On the morning of December 20, 1917, owing to constipation, the patient went to the dispensary where he was given two ounces of castor oil. He noticed a little distress in his abdomen, but nothing that he would describe as pain. He took care of his regular duties on that day and on the two following days, but remained constipated during this time, for which condition he took a dose of epsom salts, which gave him immediate relief. On Sunday, the 23rd, the patient developed an abscess in the root of a tooth and came to the hospital where the dentist drained his tooth cavity. He returned to his command, and on the 24th he held sick call and inspected all barracks, giving a full day's work. He retired at the usual time that evening, and on Christmas morning, at two o'clock, he noticed some discomfort and soreness in his abdomen, which he attributed to a large steak he had eaten the evening before. He threw the covers off and examined his side, and thought he felt a mass in the region of his appendix. He disabused his mind of the possibility of his having appendicitis, since he had not had any appreciable pain, nausea, or vomiting and contented himself with the thought that what he actually felt was impacted fæces. However, at this time, he felt a least bit nauseated. He immediately went to sleep and did not awaken until 7 o'clock, when he arose, dressed and took up his regular duties; held sick call, made out and sent in his sick report and went out for a walk and was preparing to go to the city, but because of his experience during the night, and not because of any distress or discomfort at this time, he asked one of his medical officers, who happened to be at his quarters, to examine him. This examination was made at 12 o'clock mid-day. The examiner was of the opinion that he could feel some induration and a mass in the abdomen, and urged the patient to go to the hospital. The patient decided to shave and change his clothing before doing so, and after straightening up his work about his quarters, packed his own suit case and came to the hospital, arriving at 4:00 p.m. carrying his suitcase and apparently feeling well.

Examination at the hospital: pulse 76; temperature; 98.6; respiration, normal; blood examination, 10,200 white cells.

Physical examination: abdomen was perfectly soft; on pressure over the McBurney's point, some tenderness was elicited; on deep pressure over this region, an induration was perceptible to the palpating fingers.

The patient was immediately sent to the operating room, where, upon opening the abdomen, the cæcum was found bound down by a recent exudate, the appendix was located adherent to the omentum, lying entirely within the true pelvis. The intestines were carefully packed off with gauze and upon separating down to the appendix, free white and creamy pus escaped. By a very careful and painstaking blunt dissection with the gloved fingers, the appendicular mass was brought up and tied off, without in any way contaminating the surrounding viscera. This pocket was carefully swabbed out with sponges moistened in 1 per cent lysol, drainage was carried into the bottom of the cavity, the abdomen closed and the patient placed in the Fowler position and given normal salt solution according to the Murphy plan. The patient contracted pneumonia during convalescence and continued the abdominal drainage for several months, but finally went on to complete recovery. The pathological report of this case is given by Captain M. L. Morris: "Appendix is 6 centimeters in length. Diameter at widest part is barely 1 centimeter. It is covered throughout its whole extent with a thick gray exudative membrane which is firmly adherent to surrounding parietal as well as visceral peritoneum. The entire distal half of the organ is necrotic. Rupture had taken place most likely at about the middle third of the distal half of the organ. The mesentery is congested, thickened, and covered by a like grayish membrane."

The right rectus border incision has been used entirely. A point is made of the introduction of the laparotomy sponge immediately upon making a tiny nick through the peritoneum. By pushing the sponge into the peritoneal cavity by means of a Mayo scissors one is enabled to keep the intestines and omentum out of the field — allowing a quick and safe manner to open the peritoneum and protect the viscera from trauma at the same time. The appendix, in the large percentage of cases, should be picked up exposing only the cæcum which procedure may be readily carried out by passing the exploring fingers into the abdomen along the inner side of the right abdominal wall, allowing them to sweep inward over the external iliac vessels until the meso-appendix and cæcum are grasped. The appendix may be easily delivered unless held by adhesions or a recent exudate.

Our experience in the management of suppurative appendicitis with rupture has taught us that, except in a very small percentage of cases with advanced abscess formation where the wall is so formed that further manipulation would allow free pus to run into the free cavity, the appendix can be taken out successfully and should be removed.

I have made this statement with some reluctance, fearing that physicians may misunderstand my position respecting acute appendicitis with rupture; however, it is made on the basis of past experience in not removing the appendix if rupture had occurred, depending upon drainage alone; then, after recovery, giving instructions to the patient to return for an operation in the event of subsequent trouble. We have found that the second operation is difficult owing to adhesions and far more serious than the ordinary operation of appendectomy. As a rule the patient is invalided for a much longer period, owing to the length of time the remnant of the appendix, acting as a foreign substance, causes drainage to continue.

The unremoved appendix is much more apt to cause further inflammatory disturbance in the abdomen, particularly abscess formation in dependent positions.

The ability of a surgeon to perform, successfully, an operation for the removal of a ruptured appendix depends upon the intelligent and painstaking methods used in the operation. With the field well packed off with gauze pads, and a line of cleavage to the appendix discovered there is no reason why the surgeon may not gently remove such a necrotic appendix, without, in my estimation, any additional risk to the life of the patient.

CONCLUSIONS

1. The chiefs of surgical services in all Base Hospitals should place before the regimental surgeons of the Division the importance of early recognition of acute appendicitis, in order that surgical intervention may be immediately instituted.

2. The administration of the triple typhoid vaccine in three doses produces a marked reaction, one phase of which we believe comes in the form of a lymphadenitis, which condition when produced in an individual suffering with a latent infection in the lymphoid tissue of the appendix would seem to predispose to an acute attack of appendicitis.

3. The administration of the triple typhoid vaccine in more, but smaller doses would probably produce the same degree of immunity without causing so severe a reaction.

4. Reliance should not be placed upon a leucocyte count as a diagnostic symptom in acute appendicitis unless it is positive. This is particularly true in a large percentage of the soldiers operated on at this camp for this condition, whose blood seems to have been affected by some agent causing a low white blood count to an extent that the normal white count of 9,500 may represent in these cases a relative leucocytosis.

5. Whether the triple vaccine is responsible for the low white count, or is a factor in predisposing to acute appendicitis, cannot be stated definitely, but the uniform clinical findings, associated with these cases, are very suggestive and a report now in progress upon the blood findings made within the first two months following the triple typhoid vaccination of the soldiers of the present draft now being inducted into service, may show even a lower leucocyte curve than those that have been examined and who may have lost some of the effect of their vaccination since they represent a period of four to nine months after inoculation.

I wish to take this opportunity to express my sincere thanks to my Commanding Officer, Colonel Joseph Taylor Clarke, to the Division Surgeon, Lieutenant Colonel Robert M. Thornburgh; to my former Commanding Officer, Lieutenant Colonel A. P. Upshur, for their hearty co-operation in this work; also to Captain Arthur H. Curtis who has been associated with me in the surgical management of this service.

THE OPERATION OF OMENTOPEXY IN CIRRHOSIS OF THE LIVER

By ELLSWORTH ELIOT, Jr., M.D., and RALPH COLP, M.D., New York

WHILE the literature contains many individual case reports of the so-called Talma operation, or omentopexy, for cirrhosis of the liver, and several excellent collections and reviews have been compiled by Greenough, White, Montprofit, Bunge and Ladenburger, a few observations made from the study of twenty-three cases operated upon at the Presbyterian Hospital during the last seventeen years may be of interest, especially from the viewpoint of factors influencing the prognosis, and from the end-results.

It will be remembered that Talma, of Utrecht, conceived the idea of his operation from the supposition that cirrhosis of the liver was caused by a mechanical factor; that is, he believed the smaller radicals of the portal vein system were partially obliterated by the deposition of newly formed tissue in the diseased liver with a resultant higher pressure in the portal vein and a corresponding effusion of fluid into the peritoneal cavity. Hence, by establishing an aiding anastomosis, the blood of the portal system might be partially diverted and shunted into the systemic circulation. The veins of the great omentum, which drain indirectly into the vena portalis, and those of the diaphragmatic surfaces of the liver and spleen, which are brought to the opposed surface of the diaphragm in the Talma operation, were, therefore, utilized as the means for bringing the portal into contact with the systemic through the internal mammary and deep epigastric veins.

This theory has met with much opposition. Hale, White, and Thomson asserted that the ascites in cirrhosis of the liver was due to a chronic peritonitis and perihepatitis; for in the postmortem findings of ten cases which survived more than one tapping, four had no cirrhosis whatsoever and six had a peritonitis, the latter due possibly either to the tapping or to the obliteration of the diaphragmatic lymphatics.

Rolleston stated that when the pressure is highest in the portal vein, the time when hæmatemesis occurs, ascites does not as a rule make its appearance; also, that in a cirrhosis of the liver existing for many years without the effusion of fluid, ascites may develop suddenly. Moreover, ligation of the portal vein in animals (perhaps also in humans, Brewer having reported one such supposed case) does not result in ascites.

Hahn, Nasse, Neckst and Pawlow believed that the fluid in the abdominal cavity might be explained by the fact that less blood passing through the liver, the percentage of toxins becomes, therefore, higher and consequently a lymphagogue action might be exerted. That the blood which had not passed through the liver did have a higher percentage of toxins was demonstrated by a series of experiments on dogs establishing an Eck's fistula (communication between the portal vein and the inferior vena cava), with depression, asthenia, clonic and tonic spasms, and coma following the anastomosis.

Whether Talma's reason for his procedure is sound, or whether other factors are instrumental is an open question. Thomson, Dickinson and Webber respectively, from postmortem examinations made upon operative cases, found the peritoneal cavity to be the seat of universal adhesions. Possibly, as suggested by Rolleston and Turner, the vascular channels of these adhesions carry off enough blood, thereby lessening the volume which passes through the liver, and this organ is thus enabled to detoxify more satisfactorily. Their suggestion perhaps resulted in the practice of rubbing the liver with gauze at operation in order to produce vascular adhesions to the under surface of the diaphragm.

In 1889, at the suggestion of Talma, Van der Menke made the first attempt at an omentopexy with a resulting death. In 1891 a patient of Schley died of peritonitis; and although a case of Lens, of Holland, lived for six months, he showed no improvement. To Morison, in 1895, is really due the credit for performing the first successful operation; the patient lived

for many years with marked improvement, dying from an attempt to repair a ventral hernia which had developed at the site of the previous incision. Since then, there have been many successes, many failures; and many changes have resulted in the operative technique and postoperative treatment.

Much has been written concerning the proper selection of cases. Drummond and Morison suggested only those cases whose ascites was due to cirrhosis of the liver. Greenough has collected from the literature cases of an omentopexy performed for ascites with rather discouraging results in cases of renal disease, tubercular peritonitis, chronic peritonitis, adherent pericardium, malaria, and syphilis.

Of 127 cases of cirrhosis of the liver admitted to the Presbyterian Hospital in the last seventeen years only 23 were chosen for operation. F. Meleney found that out of 50 cases of portal cirrhosis treated in the medical wards, 10 were transferred for operation. As a rule only those patients were selected who appeared to have enough resistance, and who had little or no evidence of nephritis or cardiovascular disease.

ETIOLOGICAL FACTORS OF THE CIRRHOSIS

Eighteen cases were undoubtedly due to excessive use of alcohol; in 2 cases syphilis was the cause; in 1 the cause was unknown, and in 2 the ascites was associated with an enlarged liver secondary to cardiovascular disease. One of these last mentioned cases died of acute cardiac dilatation directly after operation. The other, three years after operation, is still alive and greatly improved, almost equaling in the duration of the "cure," the case reported by Primrose, of Canada, of a cardiac who, tapped at least once a week during a long period of time, was relieved from further paracentesis for four years by an omentopexy. The following is a brief outline of the authors' case.

M. B., age 34, nationality, Irish; white; female; married. (Referred by Dr. Jeffrey.) The patient was admitted January 4, 1915, and discharged February 16, 1915. A diagnosis was made of cirrhosis of the liver with ascites and chronic cardiac valvular disease with auricular fibrillation. The chief complaint was swelling of the abdomen. The family history was irrelevant. The patient had scarlet fever as a child, rheumatic fever at 23, with cardiac injury and joint swelling, and mild recurrent attacks of rheumatic symptoms since. The menses have been regular. The patient has been married 12 years and has three children living and well. There had been a stillbirth three years ago. There was no history of alcoholism, and syphilis was denied by name and symptom.

The onset of the abdominal swelling had been gradual, appearing first about one and a half years ago, and accompanied by swelling of the feet. The symptoms were worse at night. For the past year the patient has suffered from gaseous eructations, nausea and vomiting. Orthopnœa has been a constant symptom from the beginning of her illness. For three weeks before admission, the patient was forced to take to her bed because of severe dyspnœa.

Physical examination shows a poorly developed, thin, and slightly dyspnœic woman. The abdomen is very large, and there are definite signs of fluid and marked œdema of the lower extremeties. The heart is hypertrophied, the apex in the sixth space; 16 centimeters to the left of the midline sounds are irregular in force and frequency. The systolic murmur at apex is transmitted to axilla, and there are rough systolic and diastolic murmurs over the base. After paracentesis, the liver edge felt as a hard, irregular, nodular mass, about one inch below the costal arch. The spleen is not palpable.

The urine is clear, amber colored, without albumin, and with a specific gravity of 1025. There are a few pus cells. Phthalein test: color in ten minutes, 43 per cent in two hours.

Blood count: white blood corpuscles 5,400; polymorphonuclears 72 per cent; hæmoglobin, 80 per cent. The Wassermann is negative in both antigens. Blood pressure 132-72. Von Pirquet's test was slightly positive; Moro test negative.

The ascitic fluid showed a specific gravity of 1020; it was cloudy, yellow, and showed a small amount of sediment. NaCl. 717. Polymorphonuclears 10 per cent; lymphocytes 90 per cent.

Electrocardiogram tracings show auricular fibrillation and ventricular extra systoles.

On January 1, 1915, the patient was tapped and 6,000 cubic centimeters of fluid obtained; on January 7, 5,600 cubic centimeters; on January 23, 7,000 cubic centimeters; and on February 10, 1915, 10,000 cubic centimeters. On February 11, 1915, an omentopexy was done under novocaine. The liver was found to be large and rough with evidence of chronic passive congestion.

The patient was discharged as improved, February 16, 1915, following an uneventful recovery.

Our follow-up notes states that on May 2, 1915, the patient feels well, has no orthopnœa, but there are signs of fluid. On May 25, 1915, the patient was tapped and 6,000 cubic centimeters of fluid obtained. Notation of August, 1916, states that no tapping has been done for the past year. The patient works around the house and her appetite is good. November, 1916: the patient feels very well but is slightly dyspnœic; there is little fluid in the abdomen. Feb-

ruary, 1917: the patient feels very well. December, 1917: fluid has collected in the abdomen very slowly; 11,000 cubic centimeters removed.

AGE INCIDENCE

It may be doubted whether age is a factor of importance, but it does appear that before the age of twenty and after the age of forty the death rate is higher. There were 2 cases under twenty years of age and both died. From the second to the fourth decade the mortality was 16 per cent, from the fourth to the sixth, 60 per cent; and all cases that were more than sixty years succumbed to the operation.

SYMPTOMS AND PHYSICAL FINDINGS

Ascites was the cardinal symptom for which the operation was performed. This was present to a variable extent in the 23 cases. Eleven had œdema of the lower extremities; morning nausea was troublesome in 9; jaundice was present in 4 and hæmatemesis occurred in but 2 patients. Of 14 cases noted in the physical examination as being poorly nourished and emaciated with the thin drawn face, and the reddened nose with dilated venules, 43 per cent succumbed to the operation. Of 8 cases having definite cardiac disease, 3 with auricular fibrillation, 2 with myocarditis, 3 with relative mitral insufficiency, 70 per cent died. In those cases where dilatation of the deep epigastric and internal mammary veins indicated the establishment of compensatory circulation, 50 per cent died shortly after operation. This may show that where the portal channels were so obstructed as to force hypertrophy of collaterals, operative interference was of little value, the functional liver tissue being inadequate for the demands.

RAPIDITY OF THE ONSET OF SYMPTOMS

There is, indeed, an interesting relationship between the suddenness with which symptoms develop and the prognosis. In 2 cases ascites developed within three months and both died. of 4 cases where the ascites was of six months' duration, 3 died; of 7 cases where the ascites developed over an extended period of one year or longer, there was no mortality. It is quite evident then, that the slower the effusion into the peritoneal cavity, which perhaps may be considered a gauge of the rapidity of the pathological process, the better the operative prognosis. Whether the number of ante-operative tappings, which were always greater where the disease was rapid in onset, are of any prognostic value may be gathered from the following tables: 4 cases tapped 15 to 25 times, mortality 75 per cent; 5 cases tapped 6 to 10 times, mortality 50 per cent; 14 cases tapped 1 to 5 times, mortality 30 per cent.

ANÆSTHESIA AND THE TYPE OF OPERATION

As far as the anæsthesia is concerned, some cases were operated upon under cocaine and novocaine, and some under a general anæsthetic of gas and ether, the former with a mortality of 29 per cent, the latter with a death rate of 37 per cent. While many authorities claim that the anæsthesia, whether local or general, has little or no effect, it must not be forgotten that most cases of cirrhosis of the liver are due to alcohol and that in this group, the risk of an anæsthesia is relatively great. The same risk may be increased still further by an associated nephritis. The operation with local anæsthesia is easily borne if the parietal peritoneum is carefully infiltrated, and if no undue traction is made in drawing the greater omentum into the wound. Furthermore, a local anæsthesia diminishes the risk of postoperative pneumonia and largely eliminates postoperative nausea and vomiting, and consequently, the frequency of a subsequent ventral hernia, although a rare complication.

The operation itself, as originally planned by Talma and carried out by Morison has undergone many subsequent modifications. Morison and Drummond advocated an incision from the ensiform cartilage to the umbilicus through which the peritoneum was opened, and a portion of the anterior surface of the great omentum sutured to the posterior surface of the parietal peritoneum. The liver and spleen had been previously vigorously rubbed with gauze, so as to promote and encourage vascular adhesions to the diaphragm. This practice obviously was attended with much shock.

Nareth modified this by bringing the omental tab in between the recti muscles and their fascia, to a position directly beneath the surface of the skin.

Schiassi, of Bologna, sutured the omentum to the posterior surface of the peritoneum and to the preperitoneal space, sewing tightly the anterior sheaths of the recti in the midline so as to insure a firm closure.

Greenough, in his collection, states that the method of Talma and Morison used in 68 cases showed improvement in 41 per cent and a mortality of 32 per cent; while the method of Schiassi used in 23 cases gave 43 per cent improvement and a mortality of 17 per cent.

The Mayos make an incision over the right side of the liver in line with the deep epigastric and internal mammary vessels so that a thorough exploration can be made. About 4 inches below, a second incision is made, through the rectus down to the posterior sheath. A tab of omentum is then drawn from the upper incision down into the pocket formed by the posterior sheath of the rectus and the muscle itself. This may be done on both sides and the intervening segment of the omentum sutured to the parietal peritoneum.

In the present series, the type of operation prior to 1908 was that advocated by Morison; subsequent to 1908, the method of Schiassi was adopted, with slight modifications. Ordinarily, a three-inch incision is made in the midline about two inches below the ensiform cartilage, the fascia of the linea alba divided, the recti retracted to either side, and the posterior sheath and the peritoneum incised. The fluid, remaining after a paracentesis twenty-four hours before operation, is further aspirated by suction through a metal catheter. In withdrawing the omentum, care is taken not to distort the position of the transverse colon. A vascular portion of the omentum is then sutured to the posterior surface of the parietal peritoneum with interrupted chromic catgut; further, the tongue of the omentum is sutured lightly to the posterior sheath of the rectus in the preperitoneal space and to the edge of the rectus muscle. Then, the sutured sheath of the rectus is closed with interrupted chromic catgut, and continuous silk is used to close the skin. After the sterile dressing, a tight binder is applied, and directions given that in case of vomiting the patient should receive manual support. The operation as a rule requires about thirty minutes.

In the early cases of omentopexy, drainage of the peritoneum was employed. It was later omitted for several reasons. First, the drainage tract might act as an entrance for infection; and furthermore, some patients drain enormous quantities of fluid, which resulted fatally in one case in spite of saline given by hyperdermoclysis, proctoclysis, and intravenously. Where drainage is omitted, some claim there is danger from the mechanical effects due to the reaccumulation of fluid after operation. But should this occur, should the fluid become sufficient in amount to embarrass either the heart or respiration, paracentesis may be employed at any time forty-eight hours after operation. One advantage claimed for drainage is that through the formation of adhesions the peritoneal cavity is partially obliterated, and hence the space is restricted for the subsequent accumulation of fluid. Ito and Omi have shown that in dogs the peritoneal cavity might be obliterated by tamponade of the abdominal cavity for twenty-four hours; yet it is very doubtful whether even partial obliteration occurs in man. In his collection of 54 cases, Greenough states that drainage was instituted in twenty, with a resultant mortality of 50 per cent; while in the 34 cases where the drainage was omitted, there was a death rate of 14 per cent. In the present series, drainage was employed in 5 cases, a mortality of 80 per cent resulting; while in the 18 cases where it was not used, there were seven deaths, or 38 per cent. Practically all surgeons have agreed that drainage is unnecessary, of no distinct advantage, and certainly multiplies materially the operative risk.

APPEARANCE OF THE LIVER

The appearance of the liver at operation is usually either hypertrophic or atrophic. In the present series, there were 3 cases of enlarged liver, one of which died; while of 13 cases of a small and shrunken liver, 7 died after operation. In Greenough's summary, there are 15 cases of an enlarged liver, 3 of which died after operation, and 9, or 60 per cent, showed improvement; and in 37 cases of an atrophic liver, 11, or 29 per cent, died after operation, while 36 per cent were improved. White, in his collection of 106 cases, mentions

the pathology of the liver and derives the following statistics:

Hypertrophic, 24; cured, 10; improved, 6; unimproved, 3; died, 5.

Atrophic, 82; cured, 38; improved, 7; unimproved, 10; died, 27.

POSTOPERATIVE COURSE

There were eight postoperative deaths in this series, seven occurring within the first eight days and one on the seventeenth day after operation. Of these eight deaths, six were due to a combination of cholæmia and uræmia; one was due to a cardiac failure, and one the result of a mesenteric thrombosis. A brief résumé of the last mentioned case is herewith appended:

J. M., age 50, male; married; German; fish dealer. The patient was admitted January 24, 1916, died February 28, 1916. Diagnosis: cirrhosis of the liver. The family history is irrevelant. The patient is markedly alcoholic having taken large amounts of whiskey daily for the past ten years. Three weeks before admission he noticed a gradual swelling of the abdomen, with a progressive feeling of great weakness, and morning nausea with vomiting. There were no hæmorrhages from the nose, mouth, or rectum. Physical examination shows a markedly emaciated man, slightly jaundiced, accentuated aortic second sound. There is marked ascites and general condition of arteriosclerosis. The urine is clear amber, specific gravity 1030; albumin faint trace, hyaline and granular casts. The blood count showed white blood corpuscles 6,000; polymorphonuclears 70 per cent. The Wassermann was negative in both antigens.

January 26, 1916. Patient tapped and 2,000 cubic centimeters withdrawn. February 9, 1916, 6,000 cubic centimeters withdrawn, February 18, omentopexy was done under gas and ether—time 20 minutes. The liver was found to be small and nodular. February 23, temperature 103° and patient feels comfortable. The abdomen is soft, slightly distended. February 26, temperature daily reaches 103°. The wound is clean. Distention is but little relieved by colon irrigation. Paracentesis removed 2,5000 cubic centimeters of dark brown fluid. Analysis of the fluid showed protein, 1 per cent; much pus; polymorphonuclears 68 per cent. February 27, the abdomen was soft except in the right lower quadrant and around to the flank where there is moderate rigidity. The patient breathes rapidly but the lungs are clear. There is slight nausea with vomiting of greenish fluid, not fæcal. February 28, the patient is very restless, irrational, and cyanotic. The abdomen is soft. Death in coma.

Autopsy by R. A. Lambert. The liver weighs 1950 grams and is typically hobnail. There is thrombosis of the superior mesenteric vein just below the mouth of the splenic vein. Acute diffuse purulent peritonitis.

Of the 75 cases of postoperative death collected by White, 14 died of peritonitis; 12 of uræmia; 10 of shock and cachexia; 3 of hæmatemesis; and 2 of intestinal obstruction. It is interesting to note that two of our cases died from what was presumably acute hepatic insufficiency — the latter characterized by a complete group of nervous symptoms, so marked, that in one case a diagnosis of meningitis was made. It will be remembered that Morison reported a similar occurrence in a case where undue excitement and depression prevailed after operation. At that time, this was thought due to the injurious effects of turning the stream of portal blood into the systemic circulation. It may, indeed, be doubted whether the anastomosis is effective in so brief a postoperative period; specimens taken at the autopsies of these two cases and of one which died six weeks after operation showed no macroscopic signs of newly formed blood vessels. Unfortunately, microscopic sections were not made.

Herewith is given a summary of two cases which showed marked symptoms of nervous character after operation.

E. K., age 19, American; schoolgirl; single. Admitted January 18, 1915; died February 15, 1915. Diagnosis: cirrhosis of the liver. The family history is irrevelant. At the age of five, the patient had had measles and scarlet fever, with no sequelæ. The patient's menses were regular, syphilis was denied, and she made no use of alcohol. For the past six months the patient has noticed a gradual swelling of the abdomen with no other symptoms. She was tapped three times in the last two months before admission, the last tapping being five days before admission. Physical examination showed a very emaciated, poorly nourished girl, with no other abnormalities except marked ascites. The urine was clear amber color, specific gravity 1030, and was negative as to albumin and microscopic examination. The blood count showed 12,000 white blood corpuscles, polymorphonuclears 75 per cent. The Wassermann was negative in both antigens; von Pirquet negative; stools negative for parasites; phthalein test showed color in ten minutes, 41 per cent in two hours.

February 1, 1915, omentopexy was done, under gas and ether. The liver was found to be small, hard and of hobnail appearance. Nine thousand cubic centimeters of clear amber fluid were aspirated.

February 13, 1915. For past few days the patient

has been getting very apathetic and there are signs of a reaccumulation of abdominal fluid. February 14, the patient is very stuporous and has suffered three periods of excitement during which she screamed and bit, and gave no response to questions. Paracentesis of the abdomen relieved the patient of 10,000 cubic centimeters of clear amber fluid. February 15, the patient is very stuporous and has voided very little urine today. Up to the present a normal quantity of urine was voided which was negative to examination. No abnormality was observed in regard to the abdomen except the reaccumulation of fluid. The patient died in convulsions. Autopsy showed a liver weighing 750 grams, of typical hobnail cirrhosis appearance. The kidneys were normal.

J. C., age 12; single; schoolgirl; Bohemian. Admitted January 15, 1917; died February 8, 1917. Diagnosis: cirrhosis of the liver. One sister died at the age of 10, from cirrhosis of the liver, thought to be syphilitic. The patient had measles at the age of three with no sequelæ. The patient had always been well until the onset of present illness. She had never used alcohol. For two weeks previous to admission, the patient noticed that the abdomen was increasing progressively in size. She had no pain, no nausea and no vomiting. She had noticed no swelling of the legs. She urinated five and six times a day and twice at night. Physical examination revealed a very thin little girl, with no stigmata of congenital syphilis. The abdomen was filled with fluid but no masses could be made out. Œdema spread over sacrum, legs and ankles.

On January 16, 1917, 6,000 cubic centimeters of pale amber fluid were removed by paracentesis. The laboratory examination reported the fluid to be ascitic, with specific gravity of 1013, protein 5 per cent. NaCl 6.4 grams per liter. Cellular examination showed polymorphonuclears 1, lymphocytes 48, endothelial cells 41, degenerated cells 10 per cent. The urine was clear amber, specific gravity 1030; albumin negative; microscopical examination negative. The Wassermann was negative in both antigens. A guinea pig inoculated with ascitic fluid at autopsy showed no tuberculosis.

February 2, 1917. Omentopexy under gas and ether. The liver was very small, hard and nodular. February 3, the patient is very comfortable. February 4, the patient screams with pain and points to upper abdomen. She seems stuporous. The abdomen is soft without rigidity, but distended; no vomiting, no nausea. No relief from colon irrigations. She voids normally. February 5, the patient appears slightly better. February 6, she has signs very suggestive of meningitis. The arms and legs are flexed, neck slightly rigid; suggestive Kernig sign. Lumbar puncture showed no increased pressure. Ten cubic centimeters of clear fluid were withdrawn; 4 cells. The Noguchi was negative; Wassermann negative; no tubercle bacilli were found. February 8, 1918, the patient died in coma.

Autopsy. The liver weighs 760 grams and measures 18 x 13 x 7 centimeters. It is small, firm, with projecting masses from 1 to 6 millimeters. The tissues between liver nodules are opaque and yellow.

Miscroscopic examination. The cells of the liver seem swollen and hyaline; innumerable groups of cells are evidently regenerating from radicals of bile-ducts. The lobular structure of the cells is entirely lost. The spleen is slightly enlarged. The kidneys are normal. The great omentum is adherent to line of incision and infiltrated with a large extensive hæmorrhage. Hæmorrhage is also present in the right lung, but very small beneath pleura. The cause of death is thought by Dr. G. MacKenzie, pathologist, to be hepatic insufficiency with amino-acid poisoning. The pain was caused by hæmorrhage into the omentum and hæmorrhages were thought to be due to the insufficient formation of fibrinogen by the liver.

END–RESULTS

When it comes to the ultimate question of the actual benefit derived from the operation, the criterion necessarily must be the relief of the symptom for which the operation was designed, namely, the diminution in the number of tappings and the final disappearance of the peritoneal fluid. The seven cases of which we have postoperative records show the following:

	Ante-operative Tappings	Postoperative Tappings
Case 1.	7 in 2 months 1 in 1 month 25 in 13 months 33 in 16 months	3 in 5 months 0 in last 16 months
Case 2.	6 in 4 months	0 in last 11 months
Case 3.	11 in 4 months (Average about 12 days.)	0 in last 4 months
Case 4.	1	0 in 1 year, 3 months
Case 5.	4 in 28 days (Average about 8 days.)	6 in 54 days. At present intervals over 14 days
Case 6.	2 in 6 months	2; 1 after 5 months, 1 after 9 months
Case 7.	Never tapped.	No tapping for past 3 years.

Therefore, in 7 cases under observation from three months to three years after operation, definite benefit has been derived. Of the 8 fatal cases after the omentopexy, 1 died at four, 1 at three, and 1 at nine months respectively, with no benefit. Five cases left the hospital as improved, but all trace of them was lost. Of the 7 previously cited recoveries, ventral hernia at the site of incision was the sole complication observed.

In reviewing his 16 cases, Grey Turner reported 5 postoperative deaths within a few days; 3 from pneumonia; 1 from uræmia, and 1 from cholæmia. Of the 11 who survived, 5

died subsequently, leaving 6 alive and well seven months to seven years after operation. This author believes that the operation proved successful where ascites was due, not to toxæmia, but to portal obstruction; furthermore, that this may be indicated when several tappings had caused no material disturbance; and patients with rapid emaciation, slight jaundice, and œdema of the extremities should not be considered as suitable risks. Ladenburger advises operation as soon as the case is diagnosed as ascites due to portal obstruction, and when, after the first tapping, there is a reaccumulation of fluid. Welp and Montprofit are even more radical, advising immediate operation. We have always believed it best to tap at least once and even more, before the operation; for occasionally a patient will go into absolute collapse following paracentesis; and rarely after a tapping or two will the patient have a return of ascites.

At the French Surgical Congress in 1904, Professor Montprofit, in an analysis of 224 cases collected from the literature, deduced some interesting statistics as far as end-results are concerned. Eighty-four cases, or 38 per cent, died within the first month — some from postoperative shock; 9 from peritonitis; 7 from complications of the heart, lungs and kidneys; 30 from late causes of cirrhosis; 8 from stomach complications; 4 from renal disease. Eleven cases were not followed up, and 25 cases were not improved. Twenty-six cases were tapped at long intervals and complained less of bleeding. Seventy cases were therapeutic cures; that is, either the ascites had disappeared or the hæmorrhages were arrested.

Bunge in his collection of 273 cases states:

	Per Cent
57 died in one month	20.8
90 not improved	32.9
35 improved	12.4
91 cured of ascites	33.0

White, excluding from Bunge's statistics and Montprofit's table the doubtful and valueless case reports and cases other than those of cirrhosis, collected 227 cases:

	Per Cent
Deaths, 75	33
Failures, 34	15
Improved, 29	13
Cured, 84	37.3

	Number of Cases
Cured for 6 mbs. to 1 year	7
Cured from 1 to 2 years	7
Cured from 2 to 3 years	17
Cured for 3 years	5

SUMMARY

In regard to the prognosis, probably the most favorable cases are those between the second and fourth decade, fairly well nourished, without severe nephritis, without cardiac lesions, without signs of compensatory circulation, which have stood a few tappings (not more than five), in which the disease has come on gradually and slowly, — the symptoms extending over a year, — where the liver was of the hypertrophic variety, and for which an operation of omentopexy was performed of the Schiassi type, without drainage, preferably under local anæsthesia. That the operation is of benefit in carefully selected cases, there can be no doubt.

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DEPARTMENT OF TECHNIQUE

INCOMPETENCY OF THE URETEROVESICAL VALVES NOT DUE TO OBSTRUCTION

By THOMAS N. HEPBURN, M.D., F.A.C.S., Hartford, Connecticut

INCOMPETENCY of ureterovesical valves not the result of intravesical pressure is quite uncommon so far as we know by reported cases. Hagner,[1] in 1908 and again in 1912, reported 4 cases of regurgitation of bladder fluid around a catheter in the ureter. He believes this phenomenon occurs only in "chronic inflammatory diseases of the ureteral orifices and is produced by infiltration and cicatricial tissue formation in this region which causes a destruction of the valve-like arrangement in the normal ureteral orifice." Two of Hagner's cases were secondary to tuberculosis of the kidney; one case was secondary to bilateral renal calculus, and one case was secondary to a previous prostatic obstruction for which a successful prostatectomy had been done. This last case, in my opinion, belongs to the more common group as being the result of intravesical pressure, and therefore does not come completely within the scope of his inflammatory etiology theory.

[1] Surg., Gynec. & Obst., 1912, xv, 510.

Fig. 1. Shows the bladder distended with 15 per cent thorium which has found its way into both ureters and both renal pelves. Note the small bladder and the normal renal pelvis outlines.

Kretschmer and Greer in 1915[2] review the cases reported before this time and add one of their own with a very good X-ray picture taken with collargol showing a dilated bladder, incompetent ureterovesical valves, dilated and kinked ureters and dilated renal pelves and calyces. They do not explain the etiology in their case, but with the cystoscopic report of trabeculation of the bladder and the roentgenogram showing dilatation of the bladder, the etiology in my opinion was very probably intravesical pressure perhaps secondary to a central lesion impossible of demonstration.

In analyzing the sixteen cases reported in Kretschmer's article, it is interesting to note that Cases 2, 3, 6, 8, and 16 give a definite history of obstruction to urination, so that intravesical pressure may have been the predominating etiological factor in causing the incompetency of the ureterovesical valves. Cases 1, 5, and 7 give a definite history of the trouble beginning with pain in the kidney region so that they can be looked upon as probable cases of ureterovesical incompetency, the result of a descending infection, and can therefore be classified with three of Hagner's cases. Cases 9, 10, 11, 12, 13, 14, and 15 are reported with no history of onset, only the cystoscopic findings being given, so that it is quite impossible to speculate as to their etiology. This leaves Case 4, which was reported by Israel as following childbirth and being ushered in by bladder cramps. He made no X-ray with shadow-

[2] Surg., Gynec. & Obst., 1915, xxi, 228.

producing fluid, but one kidney was enough diseased to require nephrectomy. This fact suggests that very possibly renal infection was the cause of the cystitis, so that this case probably belongs with Hagner's group of descending infection.

To the above cases I wish to add one which bears out Hagner's theory of inflammatory infiltration as a cause of ureterovesical valvular incompetency, but which differs from his cases in that the inflammation apparently started in the bladder instead of in the kidneys.

History. October 23, 1916. Female, age 21. Following a difficult labor 18 months ago she had dysuria and incontinence. This was so marked that her urine dripped constantly and her bladder felt "on fire." Her condition so embarrassed her that she had not left the house for over a year, being almost constantly confined to bed. She had no pain other than in her bladder. Her general health was excellent.

General physical examination showed a fairly well nourished girl, with no tenderness anywhere except over the bladder, no fever, and no leucocytosis. Cystoscopic examination showed a bladder so small that it could hardly be dilated enough to get any vision. The wall was covered with a thick whitish membrane which, when pealed off, left a raw bleeding surface. Neither ureteral opening could be located easily, and the examination was so painful that a prolonged search was not attempted.

Diagnosis, interstitial cystitis.

Treatment. At first the various antiseptics were used, but they increased her pain so that they had to be given up after a week's effort, with no benefit. It was then I made use of a suggestion, which I first saw in an article by Caulk, of using bulgaris bacillus, mixing an ounce of an emulsion of bulgaris bacillus with an ounce of saturated sugar solution, and injecting it into the urethra with a blunt-nosed syringe. Within 48 hours she was relieved of pain, and within 4 days she began to have a little control of her bladder sphincter. These daily injections were continued and she improved so that at the end of a month I could cystoscope her with ease.

At second cystoscopic examination the bladder could be dilated to 75 cubic centimeters. The wall showed chronic cystitis. The right ureteral opening was dilated to 6 millimeters in diameter. It admitted a No. 7 F. catheter easily and cloudy urine flowed freely. A specimen sent to the laboratory was reported filled with pus cells. The left ureteral opening was dilated to 5 millimeters in diameter. It admitted a No. 7 F. catheter easily and cloudy urine flowed freely. A specimen sent to the laboratory was reported filled with pus cells.

A differential renal function test was made by injecting 6 milligrams of phenolsulphonephthalein intravenously. The right kidney excreted it in 4 minutes and in 15 minutes, 7 per cent; the left kidney excreted it in 4 minutes and in 15 minutes, 7 per cent. There was bladder leakage around the catheters, 15 per cent.

A roentgenogram was taken after introducing by gravity through a bladder catheter as much 15 per cent thorium as she could comfortably stand. This picture is shown in Figure 1. It demonstrates a small bladder, with incompetent ureterovesical valves and approximately normal renal pelves.

Within two months after beginning the bulgaris bacillus injections the patient could hold her urine for an hour at a time, and she left the hospital to go to work. A month later she returned at my request for another cystoscopy.

A third cystoscopic examination showed the bladder capacity only 150 cubic centimeters. The mucosa was normal. The right ureteral opening was 5 millimeters in diameter. The left ureteral opening closed almost to normal size.

A second roentgenogram was taken as before and very little of the thorium ascends into the left ureter but the right valve is still quite incompetent.

The patient is now away doing war work and is apparently in the best of health.

CONCLUSION

1. Acute interstitial cystitis may cause incompetency of the ureterovesical valves with an ascending pyelitis, even when there is no history of retention, or sign of bladder distention.

2. That treatment of interstitial cystitis by injection with bulgaris bacillus may be a valuable aid.

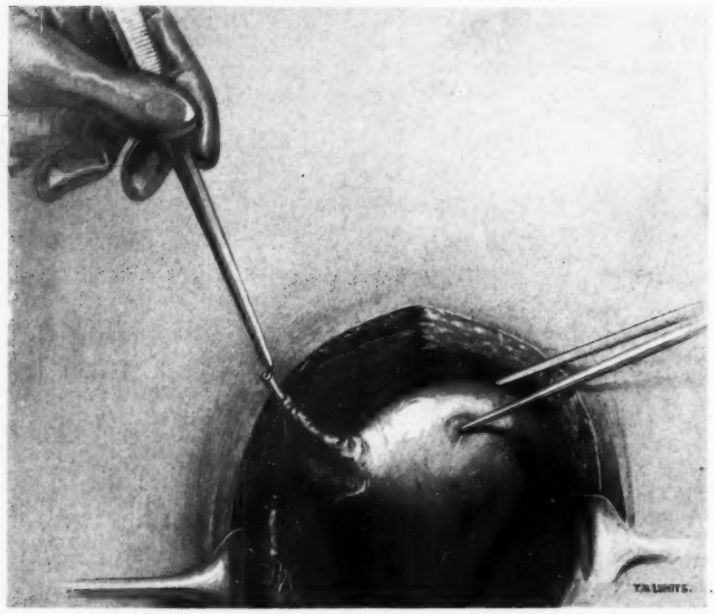
3. That recovery of the normal function of the ureterovesical valves after prolonged incompetency is a problem of which we know little, and it is to be hoped that urologists will make a point of noting the degree of recovery in reporting such cases.

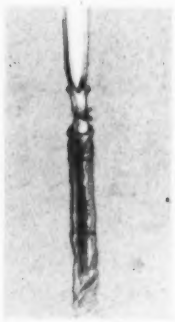
AN OPERATION FOR THE PRODUCTION OF STERILITY

By RALPH C. CUPLER, M.D., F.A.C.S., Chicago
Professor of Clinical Surgery, Loyola University; Surgeon, St. Anthony's Hospital

IT is occasionally important to sterilize a woman without removal of any of the organs. Simple tying, section or exsection of the tube as recommended by Blundell in 1812, is quite inadequate as the lumen of the tube becomes readily re-established. Abolition of the tubes, a wedge-shaped section being removed from each uterine cornu including the tubal mucosa, is safe. Also division of the tube and the cut ends covered with broad ligament is considered safe.

During the past ten years I have used successfully the operation to be described. I have had





opportunity to observe the result of the procedure many years after it was performed and on each occasion there was no attempt by the tube to re-establish itself. In favor of this method is the fact that the tube can be made patent again by salpingostomy or end-to-end anastomosis.

This operation can be done rapidly and I believe secures sterility in 100 per cent of the cases. There is only a small portion of the ovaduct removed. It is based on a sound surgical principle. Crushing out of the mucosa thereby doing away

with the endothelial cells, bringing in contact the ribbon of connective tissue, gives to us a condition most favorable to healing and minimizes the possibility of the endothelial cell regeneration and the consequent re-formation of the duct. It is quite true and is keenly recognized that the operation of election in any surgical condition is the one that gives the most to the patient. I simply present my experience in the management of this class of cases, and the method I have used.

Operation. Infiltration or general anæsthesia. The abdomen is opened by a suprapubic, median incision. The tube is delivered and held in a position to be easily handled. A No. 1 catgut is placed around a small area in the broad ligament including the blood-vessels supplying a limited part of the tube. The tube is then divided and a peritoneal cuff on the proximal end is turned back, the denuded muscle and mucosa is crushed in the bite of an angiotribe. No. 0 catgut ligature is applied in the crease, the cuff is brought over and a ligature applied. The distal end of the tube is ligated, and both ends approximated and the rent in the broad ligament closed. The relation of the structures now appear quite normal. The opposite tube is treated in the same manner and the abdomen is closed in the usual way. The operation can be done by the vaginal route. I have used it in the vaginal interposition operation for procodentia uteri.

LOWE'S COLOSTOMY RECEPTACLE

By Captain HORACE A. LOWE, M.C., U. S. A.
Base Hospital, Camp Shelby, Miss.

I AM prompted to report this apparatus because it has proven a success in my hands and is, I think, a distinct improvement over ones commonly used.

The unfortunates who have to spend the balance of their days, or even part of them, with colostomy openings are entitled to everything possible that will make their condition more bearable and if this will help, if only in a small way, I shall feel grateful. The apparatus is simple, efficient and can be self-adjusted.

It is constructed like the ordinary colostomy receptacle with the pneumatic ring and rubber pouch. Instead of being held in place by a belt, it is held by an ordinary truss spring, which distributes an equal pressure around the opening, the pressure remains constant with changes of the body position and, therefore, prevents leakage. The advantages claimed are:

1. The spring attachment keeps a constant pressure on the pneumatic ring which is equally distributed and prevents leakage.

2. Does away with the perineal straps and belt.

3. The constant pressure of the spring preserves the contour of the abdomen and prevents the tendency to hernia.

In this connection, I should like to point out a few of the salient points in dealing with colostomies. The incision should be made well toward the median line opposite the anterior superior spine, if a receptacle is to be worn; otherwise the rim of the receptacle will encroach upon the crest of the ilium and make it hard to adjust to prevent leakage. Constant pressure against the bone also produces irritation and makes the apparatus uncomfortable.

The skin and fascia incision should always be small with close approximation of the skin and fascia to bowel, allowing it to remain thus for twenty-four to forty-eight hours, depending on amount of obstruction, before opening the bowel. If it is necessary to explore the abdomen, a median incision or rectus incision should be employed. The colostomy incision should never be made large enough for an exploratory operation.

THE POCKET METHOD OF CLOSING SKIN DEFECTS

By JOSEPH E. FULD, M.D., New York
Instructor in Operative Surgery, College of Physicians and Surgeons, Columbia University; Assistant Visiting Surgeon, City and Governeur Hospitals

THE successful outcome in plastic operations depends far more on careful attention to details than anything else. Every possible effort should be made to observe the apparently minor points. If the operation is a failure, the final result may be even worse than the original deformity and in many cases the operation cannot be repeated.

The pocket method of skin grafting consists in raising a bridge of skin and subcutaneous tissue from the underlying aponeurosis, inserting under it the part to be grafted, and fixing it there until union between the raw surfaces has taken place, when the two pedicles are cut. It is very important to take a Wassermann and never to operate while there is an active syphilitic process.

This method is indicated when it is necessary to cover large skin defects of extremities as after injuries of hand, wrist, finger or foot especially about their joints; to remove cicatrices which bind down tendons and interfere with action of muscles or their tendons; and to restore flexion or extension.

Fig. 1. Incisions for the two pedicled skin graft.

The patient, a female, age 20, came under my care about October 1, 1917, and was admitted to the Park Hospital, October 6, 1917. Family and past history negative. While working in a laundry, about 2½ months before her admission to the hospital, her right hand was caught in a mangle. The skin and subcutaneous tissue were torn off the dorsum of the hand, exposing all the extensor tendons. The wound refused to heal. The extent of her injuries is clearly shown in the accompanying photograph. In addition to the skin defect due to cicatricial contraction of the dorsum of her hand, the extensor tendons were fixed, so that she was unable to close her hand. This made the indications for the operation twofold: (1) to cover skin defect, and (2) to prevent contraction.

Preparation of the patient. My first effort was to improve her health and strength by general hygienic, dietetic, and tonic measures.

The operation which I planned for her relief was to transplant from the abdomen to the dorsum of the hand a strip of normal skin, broad enough to fill the gap left after excision of the scar tissue binding down the extensor tendons and allow the flexor tendons to act in the closing of the hand.

Preparation of the wound. The skin of hand and abdomen was surgically prepared. At the first step of the operation all the cicatricial tissue was removed, then the edges of the wound were freshened and elevated allowing them to retract away from the field, so as to free the field far above and below, thus preparing the bed for the transplant.

Two parallel vertical incisions were made extending from a little below the left nipple to a line on a level with the umbilicus, cutting right down to the aponeurosis of the abdominal muscles, including in the flap the entire thickness of the skin and subcutaneous tissue of the abdominal wall. The formation of adhesions is prevented by the fat which is present in the flap. The far edges of

Fig. 2 (at left). Condition of the hand before operation.

Fig. 3. Condition of the hand six weeks after the operation. Sutured edges were united by primary union leaving only a faint scar.

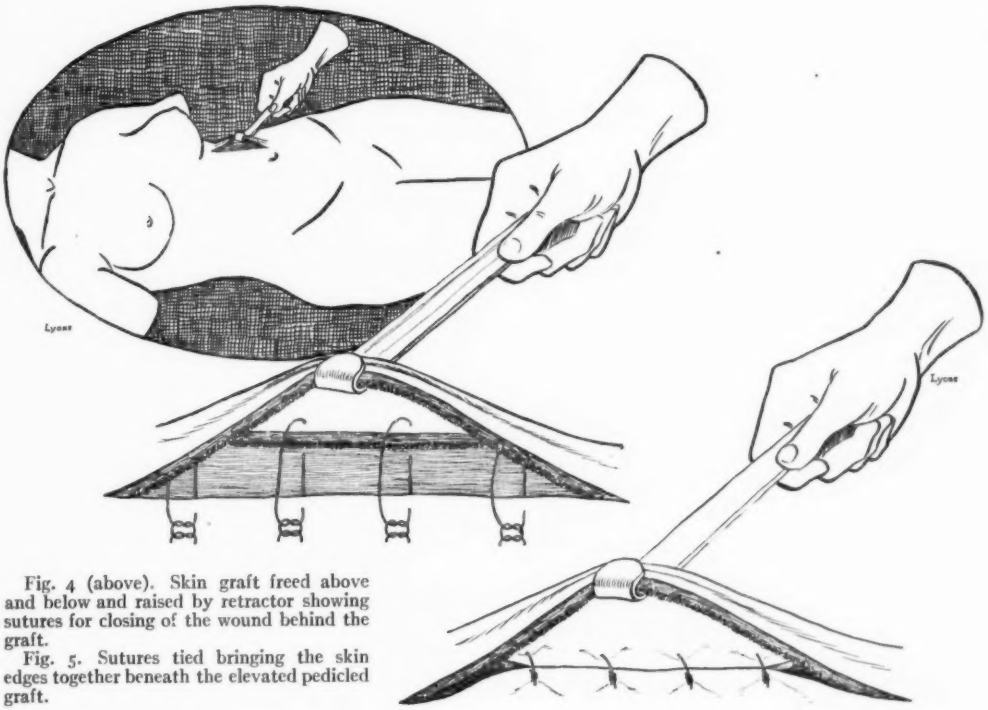


Fig. 4 (above). Skin graft freed above and below and raised by retractor showing sutures for closing of the wound behind the graft.

Fig. 5. Sutures tied bringing the skin edges together beneath the elevated pedicled graft.

the wound were sutured together under this flap so as to restore the continuity of the abdomen.

The patient's hand was now passed beneath the flap with the palm facing the abdomen and the dorsum in contact with the under surface of the flap. The skin edges of the hand wound were sutured to the flap, which must be gently handled, carefully adjusted, and precisely sutured, as accuracy of apposition is essential. From the natural contractility of the skin it contracts and shrinks considerably, so it must therefore be one-third wider than the defect to be filled, and longer than apparently necessary to avoid undue contractility on the pedicles. Perfect hæmostasis, strict asepsis and antisepsis are necessary to assure success. The flap lived in its entirety. The sutured edges were united by primary union. The cut edges of the flap bled freely, which spoke well for a successful outcome. The freshly cut edges were now sutured to the hand and a dry gauze dressing held in position by a bandage applied. The position in which the hand is held is a very comfortable one. The hand and arm must be kept perfectly still for 15 days, and the best way to procure this immobilization is to retain arm against abdomen with adhesive plaster.

The graft is released from its pedicle 15 days after the operation.

Under local anæsthesia on the 15th, both pedicles of the bridge flap were entirely severed and the hand released from the abdomen. The cut edges of the flap bled freely, which spoke well for a successful outcome. The freshly cut edges were now sutured to the hand and a dry dressing applied.

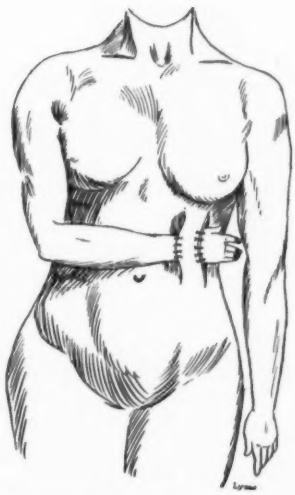


Fig. 6. Hand passed beneath the flap with the palmar surface facing the abdomen and the dorsum in contact with the under surface of the flap. The skin edges of the hand are sutured to the skin graft.

Final result. The skin defect is perfectly covered. The patient is able to flex and extend the fingers. The hand grip is strong; the esthetic effect marked; the only scars shown are the suture lines at the union of the flaps, replacing the unsightly and awkward scar of a granulating surface.

CONCLUSIONS

The advantages of this method far outweigh the disadvantages of a two stage operation.

1. The blood supply from two pedicles insures the necessary viability.
2. There is no stimulation of connective-tissue formation and resultant cicatricial contraction.
3. The presence of fat in the flap prevents adhesions to the tendons below.
4. The raw surfaces are approximated and held in position with ease.
5. The two pedicles act as splints to hold the grafted portion in position.
6. At least six weeks is saved in healing time.
7. The excellent pressure surface is of great advantage in this part of the body exposed as it is to rough usage, traumatism, constant flexion, and extension.
8. Finally it is the method of choice when the sliding method is impractical.

A SIMPLE METHOD OF EXCLUDING THE SEPTIC END OF THE BOWEL DURING INTESTINAL RESECTION

By R. E. FARR, M.D., F.A.C.S., Minneapolis, Minnesota

IN doing an intestinal resection, numerous methods have been devised for protecting the peritoneal cavity from contamination. The remaining ends of the bowel may be sterilized by cauterization or inverted, and the same treatment may be accorded the portion of the bowel which is to be excised, but this takes time. For the method recommended the materials are always at hand, and the septic bowel may be excluded in an instant after its division without the slightest possibility of contamination.

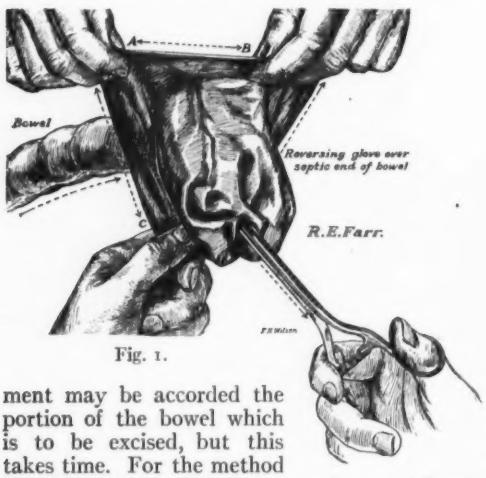


Fig. 1.

At the first point of division of the bowel a heavy clamp is placed upon the portion which is to remain, while the portion to be excised is grasped by a long-handled forceps, the blades of which have been inserted into two fingers of a sterilized glove (Fig. 1). After the division of the bowel by knife, scissors, or cautery, the end that is to remain may be treated in the usual manner. The end which is to be removed is held in the forceps, as illustrated (Fig. 1); the operator then grasps the glove at point *C* with his left hand, and his assistant grasps the glove at points *A* and *B*. By making traction, the sleeve of the glove assumes a triangular form (Fig. 2); the septic end is then made to disappear by making traction upon the forceps, the glove being turned inside out over the bowel and there securely clamped by means of a forceps.

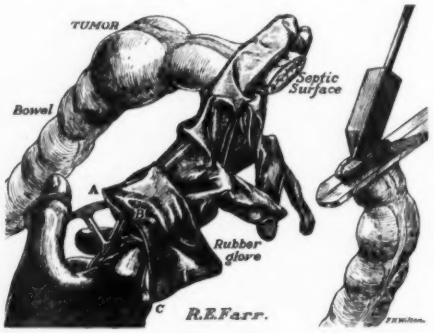


Fig. 2.

This principle may be applied in many other operations where a septic mass with a pedicle is to be isolated.

SIMPLIFIED TECHNIQUE FOR THE INTRAVENOUS INJECTION OF SALVARSAN OR ANTITOXIN IN COMBINATION WITH NORMAL SALT SOLUTION

By PETER C. CLEMENSEN, M.D., Chicago

ABOUT two years ago, I began using normal salt solution more or less regularly in all intravenous injections of salvarsan and the newer preparations, diarsenol, arsenobenzol and nov-arsenobenzol. I had noticed that the watery solution prepared according to the directions of the manufacturer would in many patients cause a painful sensation in the vein. I think most physicians will bear me out as having observed similar symptoms.

Also I preferred to use the salt solution because with it it is possible to inject any fluid into the vein very slowly at blood temperature, 100° F. This cannot otherwise be done with a small volume of fluid, as it cools too rapidly. Since I started to give antitoxins intravenously, I have observed that it is very important that the serum be heated to blood temperature before starting to inject it and to maintain it at that temperature until it is all injected.

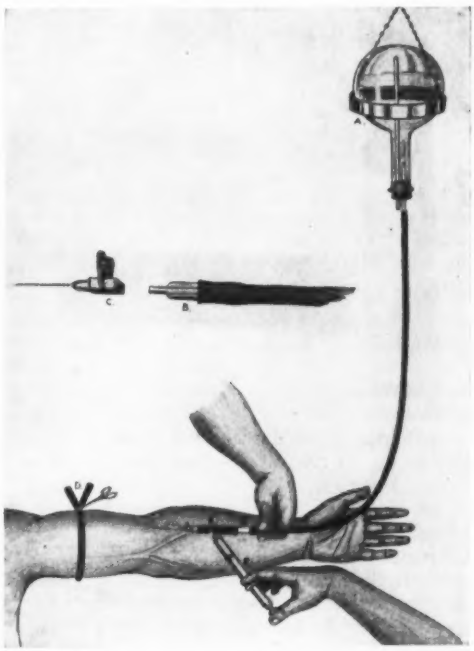
The apparatus which I have devised for this purpose consists of a quart flask; a rubber cork[1] with two quarter inch holes; two pieces of one-fourth inch glass tubing; a large thermometer, one-fourth inches in diameter; two lengths of pure para rubber hose; two glass hose connections, one of them ground in one end to fit a Fordyce needle; one 20 cubic centimeter Luer syringe; one Fordyce needle; a piece of rubber hose and a pair of artery forceps for a constrictor for the arm.

The technique I use is as follows:

Several flasks of normal salt solution are sterilized and corked with cotton stoppers, covered with gutta percha tissue and are ready for use. I remove the gutta percha and cotton stopper and in its place insert the rubber cork in the flask with the short glass tube and the thermometer (all previously sterilized). Then the flask is placed on an asbestos pad over a Bunsen burner (or gas stove) and heated until the salt solution shows a temperature of 110° F.

The thermometer is removed and the long glass tube inserted through the hole in the cork which it formerly occupied. This tube should be brought close to the bottom of the flask as it is to act as an air tube. The sterilized rubber hoses and their connections are now fastened to the short glass tube in the flask and the same inverted and held by an assistant, or suspended in a ring holder, *A*, as illustrated.

The arm to be used for the injection, having previously been prepared, is placed at right angles to the body and the constrictor rubber band, *D*, stretched and clamped about the arm to bring out the veins. The Fordyce needle is next inserted into the vein. The blood will ooze freely from the needle if it is in the vein until the rubber constriotor is removed, which by the way is done at this time. I now allow the salt solution to run through the hose (be sure to have the glass connection *B* connected to the hose) for in that way all the air is quickly removed from the hose.



Author's apparatus showing method of administering salvarsan or antitoxin in combination with normal salt solution.

[1] The rubber cork and hoses should be of the acid cured variety.

When all the air is out of the hose, let a little of the salt solution run into a medicine glass and test it (by an ordinary fever thermometer), to see if it tests 100° F. If it does, connect the ground end of tube, *B*, to the Fordyce needle, *C*, and allow the salt solution to run into the vein.

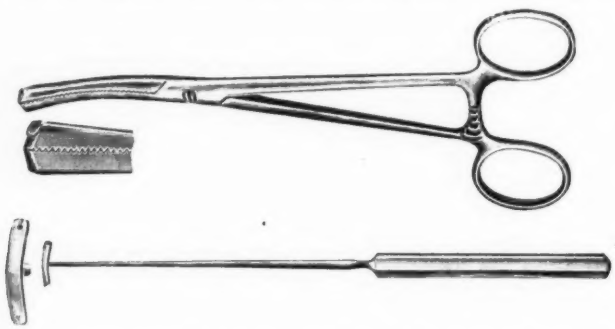
I use the short hose marked *E*, as a sort of outside vein into which I jab the needle of my antitoxin (or salvarsan) syringe marked *F*. By gentle pressure the contents of the syringe is now allowed to flow into the hose to mix with the warm salt solution. If too much pressure is used the solution from the syringe, *F*, immediately backs up and shows in the glass tube, *G*, which acts as an indicator and assures a perfect mixture and flow.

It might be of some interest to mention that I started to use this apparatus in injecting physiological sea-salt solutions with salvarsan in some cases of syphillis of the liver which resisted all forms of antisyphilitic treatment. But, I now like this apparatus so well that I use it in all cases of intravenous injection of salt solution and combinations of the solution.

A NEW FORCEPS FOR THE CONTROL OF HÆMORRHAGE AFTER THE REMOVAL OF TONSILS

By WILLIAM A. GROSS, M.D., Chicago

THE common method of controlling hæmorrhage in surgery is that of applying an artery forceps and ligature wherever possible or practical. This procedure of hæmostasis may also apply to throat surgery. However, more or less difficulty has been experienced in the past in applying forceps and ligature in such cases owing to the inaccessibility of the field of operation.



The object of the forceps illustrated is to simplify this procedure in surgery of the throat and other operative fields, where difficulty is experienced in applying the ordinary hæmostat. The special hæmostat has a groove at the end of one of the jaws in which a piece of No. 1 catgut is inserted. After sponging the cavity, the hæmostat with the ligature in position is applied to the bleeding point. One end of the ligature is swung around the forceps and a double knot is tied which is then pushed down as far as possible, whereupon the "tying instrument" is placed in position. After placing both ends of the ligature into the slots of the "tyer," the free ligature-ends are held in one hand while pushing, with a seesaw motion, firmly down with the other hand until the knot is firm. Then the "tyer" is released and, with the forceps remaining in position, the second knot, which has been made with a single twist, is pushed down into position with considerable pressure. After completing the knot the "tyer" is removed and the free ends of the ligature are cut off with a pair of scissors, and the forceps may be removed.

The hæmostat is so designed that the knot will slip easily over the ends of the instrument, which obviates the difficulty heretofore found in applying the ordinary artery forceps in a cavity, such as is left after removing a tonsil.

ANTHRAX

Report of a Case

By LOUIS J. PRITZKER, M.D., Chicago
Captain, M.C., U. S. A.; Chief of the Surgical Service, U. S. General Hospital No. 29, Fort Snelling, Minnesota

BECAUSE of certain unusual features, the following case is reported at the suggestion of the Commanding Officer, Major A. Schuyler Clark, M.C.

Private W. I. T., Infantry, was admitted to the Surgical Service, on August 19, 1918, having been transferred thereto from the Medical Service with the diagnosis of anthrax.

On admission the following history was obtained: Onset of illness June 23, 1918, when patient noticed a small pimple at about one inch below the angle of his right jaw. The morning following the right side of his neck became considerably swollen and stiff, felt as if it were paralyzed and produced a choking sensation, though it was not very painful. At that time too the pimple was "discharging a little" and the patient felt generally uncomfortable, very feverish and chilly, but not weak.

About a month ago the patient visited a shed, containing straw that had been lying around for some time and was damp. He gathered some of this straw, stuffed a tick with it and used it as a bed up to within about two weeks of the onset of symptoms. This was absolutely all the information that could be obtained, on very careful and painstaking questioning of the patient, as regards his coming directly or indirectly in contact with horses, cattle or sheep.

On June 27, 1918, he became very sick, was taken off of a transport train, on which he was a passenger, brought to this hospital and admitted to the Medical Service. On that day his condition, as described in the records, was as follows: "Man came in very ill, with marked swelling of right side of neck and jaw, with a large pustule beneath the angle of the jaw. Appearance raised, elevated border with depressed center, looking dark and gangrenous. Swelling extended downward over upper part of sternum. Very painful, red, and resembling erysipelas. Marked adenitis, patient unable to move head." Temperature 103.2°, pulse 102, respirations 24. In the afternoon of the same day his temperature rose to 104°, pulse 102, respirations 36. The same afternoon a blood examination by Lieut. W. J. Carson, M.C., showed white corpuscles 20,000, hæmoglobin 90 per cent, small mononuclears 8, large mononuclears 2, transitionals 1, polymorphonuclears 88, and eosinophiles 1. *Blood smear showed positive for anthrax.* Throat swabbing showed the prevailing organism to be the bacillus anthracis. Swabbing from the nose was negative for anthrax but showed staphylococci. Urinalysis negative.

The treatment consisted principally of the injection of ten (10) drops of a 10 per cent solution of carbolic acid in glycerine for five successive doses at four-hour intervals. The first dose was given intravenously, the subsequent ones intramuscularly. In the morning of June 28, the temperature dropped to 102°, pulse 102 and in the afternoon of the same day there was a further drop of temperature to 99.2°, pulse 95. Thereafter the temperature, pulse, and respirations varied between 96 and 98.6, 54 and 88, and 14 and 24 respectively until the termination of the illness.

On August 19, 1918 (the day of transfer of the patient to the Surgical Service) his condition was found to be as follows: temperature 97°; pulse 68; right sternocleidomastoid and pectoralis major muscles indurated causing limited motion of the head; œdema and swelling, about the size of a hen's egg, over right sternoclavicular articulation; no open wounds but a scar, about one inch below and slightly external to the right angle of the jaw.

A specimen of blood, obtained from the patient, was sent to the laboratory for examination and a large hot boric acid dressing applied over the swelling. On August 22, 1918, the laboratory report by Sgt. 1st Class, D. Cross, M.C. read as follows: red corpuscles 5,000,000, white corpuscles 8,400, blood culture positive for anthrax. On August 27, a saline solution of this culture was injected intravenously into a rabbit. Results and post mortem findings appended herewith. On September 6, 1918, another specimen of blood from the patient was studied by Lieutenant D. B. Roach, M.C.; in this instance too the report of positive cultural findings for anthrax was returned. A specimen of this latter culture was injected intraperitoneally into a guinea pig and the results of this is also appended herewith.

The treatment of the patient at this time was principally supportive plus the local daily application of large hot boric acid dressings which applications were later changed to the following:

Rx	Grams
Extracti belladonnae	4
Plumbi iodidi	4
Lanolini q. s. ad	30

The patient kept steadily improving and by the middle of September there was no longer a vestige left of the swelling or any of the symptoms. Repeated examinations of blood, throat, and nose cultures and fæcal analysis and urinalyses all showed negative results.

The unusual features in this case are (1) the extraordinary long period of incubation (if the history is to be relied on); (2) the persistance of the bacillus anthracis in the blood from practically the first day of the illness up to almost the time of complete recovery, and (3) the demonstrability of the bacillus in the blood.

With reference to the latter we find the following in literature: Osler (1): "It is to be remembered that the blood may not show the bacilli in numbers until shortly before death." Simon (2): "Adequate data from which a blood picture of anthrax could be constructed are wanting. In infections of some of the lower animals the corresponding organism may be demonstrated in the blood in large numbers. In man this is apparently possible only in exceptional instances, late in the disease, when general

septicæmia has developed, and even then not in all cases." Hiss and Zinsser (3): "Although the bacilli are not demonstrable in the blood until just before death, they nevertheless invade the blood and lymph streams immediately after inoculation and are conveyed by these to all the organs."

LABORATORY INVESTIGATIONS

By Lieutenant W. S. Carson. A blood count made June 27, showed white corpuscles 20,000; red corpuscles not recorded; eosinophiles 1; polymorphonuclears 88; large mononuclears 2; small mononuclears 8; transitionals 1; hæmoglobin 90 per cent. Blood smear and throat culture were positive for anthrax. Nose culture negative for anthrax, positive for staphylococcus. Urinalysis on June 27, June 28, July 3 and July 6 negative.

By Sergeant Cross. A blood count taken August 22 showed red corpuscles 5,000,000; white 8,400. Five cubic centimeters of this blood was cultured in 150 cubic centimeters of dextrose beef broth, and incubated for 24 hours at 37° C; this resulted in the formation of a white pellicle. Examination of the broth showed pure culture of gram positive bacilli. Transplanted to agar and incubated for 24 hours at 37° C. showed anthrax in filaments of from 2 to 20 elements; many of the organisms containing endospores. Incubated again for 48 hours and most of the vegetative forms changed to spore forms. The agar plates showed the characteristic anthrax-like colonies. On August 27, one and one-half cubic centimeters of saline agar slant suspension was injected intravenously into a rabbit. The animal died in 15 days after an illness of 3 days.

By Lieutenant Roach and Sergeant Cross. Autopsy examination of rabbit on September 11 showed the peritoneum to be congested and peritoneal cavity containing large quantity of clear fluid. The liver was enlarged and very much congested, as was the spleen. Cultures from various organs and heart's blood showed pure culture of anthrax. September 6, another specimen of blood from patient was studied in broth, agar slants, and plates showing a pure culture of bacillus anthracis. This culture was injected intraperitoneally into a guinea pig. The pig developed symptoms in two hours and died in 8 hours. Autopsy showed the tract along path of inoculation inflamed, the peritoneum congested and containing large quantities of exudate. The spleen was enlarged and congested. Cultures from organs and exudate studied in broth and agar smears showed pure culture of bacillus anthracis.

REFERENCES

1. Osler, Sir William. The Principles and Practice of Medicine. 1912, 8th ed., p. 149.
2. Simon, Charles E. Manual of Clinical Diagnosis. 1918, 9th ed., pp. 584 and 585.
3. Hiss and Zinsser. A Textbook of Bacteriology. 1918, 4th ed., p. 571.

PERITONEAL DRAINAGE

By C. L. HEALD, M.D., F.A.C.S., Cedar Rapids, Iowa

THE impossibility of continuous drainage of the peritoneal cavity has been proved conclusively by animal experimentation. Within a few hours, probably less than 24, adhesions completely isolate the drain tract. Any drainage after that is from the drain tract alone. Yet clinical experience has proved the necessity of some form of drainage in the presence of pyogenic peritoneal infection. Since all drainage from the peritoneal cavity ceases after 24 hours, whatever benefit it brings must be secured during that brief period.

Tube drainage of the abdominal cavity is against gravity and depends upon the overflow. Dependent drainage can only occasionally be employed. "Mikulitz long ago was convinced of the physical and pathological impossibility of ideal tube drainage." (Yates.)

Gauze as a drain depends upon capillarity, and, as soon as it becomes saturated, ceases to drain, becoming an obstruction to drainage.

Free pus in the peritoneal cavity may be removed by exposure and sponging, or by irrigation; but both these procedures may be attended with grave danger, and, in many cases, it is safer not to attempt to remove the pus at the operation, but to rely upon rapid, efficient drainage. To such cases Murphy referred in his dictum: "Get in quick; get out quicker."

Ideal peritoneal drainage should remove the pus from the bottom of the cavity with the minimum of injury to the patient.

The double caliber glass tube with movable gauze wick, as shown in the accompanying illustration, comes nearer meeting these requirements than any method I have used. The double tube is one-half inch in (outside) diameter. The lower end is closed except for an oval opening one-eighth inch in its long diameter, one-fourth inch from the lower end on each side, and a small opening in the bottom. The longitudinal septum extends to one-fourth inch from the lower end.

One end of a gauze wick, one inch wide and several yards long, is inserted in the upper end of one "barrel," and is pushed down its lumen to the lower end with a small probe, pulled out of

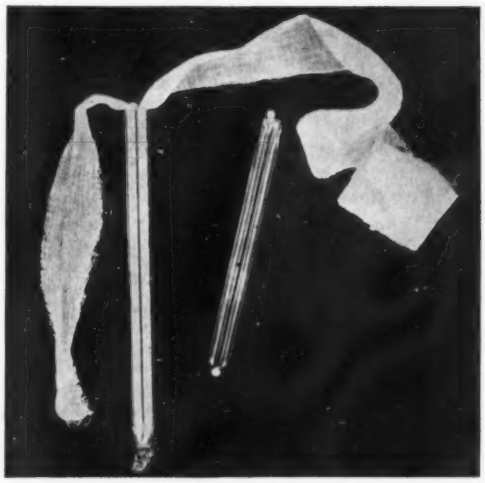
the opening in the bottom, the end reinserted through this opening and pushed up through the other "barrel," passing around the smooth lower end of the septum.

The tube, threaded with the wick, is inserted to the bottom of the cavity and the wound is closed completely around it. The tube should be long enough to project above the dressings, which are covered and protected by a sheet of rubber dam, through a small stretched opening in which the tube has been previously passed. The roll of sterile gauze wick in a cloth bag is pinned outside the dressings and covered with a sterile towel.

During the first 24 hours, at more or less frequent intervals, depending upon the quantity of purulent secretion, the nurse, with sterile-gloved hands, steadies the tube with one hand, pulls the wick through with the other until it comes through dry, cuts off and removes the soiled portion, and replaces the sterile towel, without having disturbed the patient. After 24 hours, the tube, having served its purpose, is removed, and replaced by a small "cigaret," or by any form of drain the surgeon may prefer.

The method may be used in the drainage of any cavity where dependent drainage is impracticable, but in peritoneal infections from perforations, it will probably be found most useful.

With this method of drainage it is not necessary to leave a large portion of the wound open, as is often advisable with the usual methods, resulting so frequently in postoperative hernia.



It has the advantage of gauze drainage without its disadvantages.

It is similar in its effects, yet superior, to dependent drainage, in that the tube will not, with proper attention, become obstructed.

It drains the bottom of the cavity, while, with the usual methods, overflow drainage only is obtained.

Finally, by this method, the maximum drainage is secured during the few hours when drainage of the peritoneal cavity is possible.

TRANSFUSION APPARATUS

By R. E. FARR, M.D., F.A.C.S., and EARL W. GILROY, M.D., Minneapolis, Minnesota
From the Clinic of R. E. Farr, Farr Pavilion, St. Barnabas Hospital

THE efficacy of the citrate method of transfusion seems to have been established. This method has made the operation comparatively simple. In order further to simplify the technique we have made use of some of the well-known laboratory methods, adapting them to this new field. This method of withdrawal of the donor's blood has been used by many men for various purposes, but the application of the second part of the procedure we think has not been described.

The apparatus consists of a liter Erlemeyer flask arranged in the same fashion as an ordinary laboratory wash bottle (Fig. 1) with a long glass tube extending from the bottom of the flask through a rubber cork and outward, having a bend of 45 degrees on the outside, *A*. One other

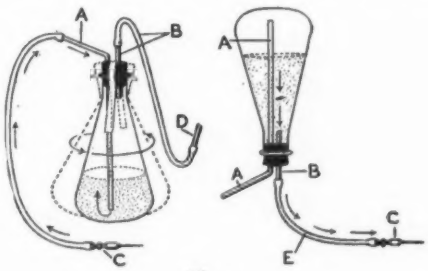


Fig. 1.

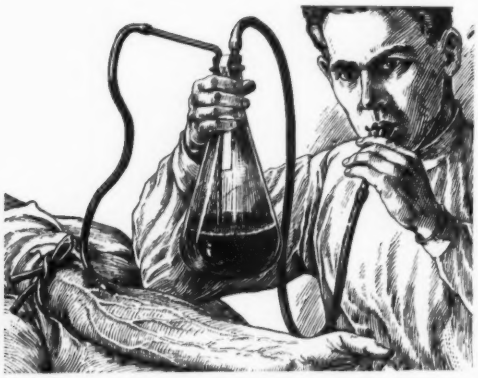


Fig. 2.

Fig. 3.

short tube, *B*, extends into the bottle about one-half inch and about one and one-half inches on the outside. Tube *A* is connected with a rubber tube and at the distal end of the rubber tube there is an adapter, *C*, to fit either a Luer or record needle. Tube *B* is plugged loosely with sterile cotton and is connected with a long rubber tube, at the distal end of which there is a glass tube, *D*. The glass tube is likewise plugged with cotton and is used as a mouthpiece for the operator from which point by means of suction he is able to create a negative pressure in the bottle.

In the preparation of the patient the usual technique is followed as to the application of the constrictor, sterilization, etc. Citrate solution in sufficient quantity to make a 0.2 per cent solution of the citrated blood may be introduced into the bottle before the cork is inserted or this may be done fractionally by suction after removing the adapter and placing it in citrate solution.

We usually hold the cork in place by means of adhesive tape so that the second stage of the procedure (Fig. 2) may be performed without danger of the cork coming out at the time the bottle is inverted. With the mouthpiece in the operator's mouth, the needle, directed peripherally, is inserted into the vein of the donor and by suction negative pressure is produced in the bottle. The blood then runs through tube *A* to the bottom of the flask which is continually agitated, and the blood is at once intimately mixed with the citrate solution. If at any time the vacuum created is too great, it may induce a valvelike action at the tip of the needle, the wall of the vein closing over the orifice. In such an event the adapter is simply loosened from the needle and normal tension is restored. By this same means tube *A* may be evacuated of blood at any time and thus the possibility of the blood stagnating and clotting in the tube is eliminated.

Having completed the operation of withdrawal of the blood, which operation is almost as simple as taking blood for a Wassermann, the bottle is inverted (Fig. 3), the long tube *A* becomes the air intake, the short tube *B* becomes the tube of exit which tube is connected with another long rubber tube *E* in the same fashion as in the administration of saline by the gravity method.

The whole apparatus, including a bottle of sodium citrate (grams 2) with needles No. 16 may be autoclaved and wrapped so that the operation can be accomplished with but little preparation and with no delay. The application of these simple laboratory methods minimizes the possibility of contamination and makes for efficiency and simplicity of operation.

SUGGESTED STEP IN THE TECHNIQUE OF INGUINAL HERNIOTOMY

By MARSH PITZMAN, M.D., St. Louis
Lieutenant, Medical Corps, U. S. A.

THE very multitude of the modifications in the technique of inguinal herniotomy today in widespread use opens the question as to whether, after all, we have really gotten to the root of the matter. The essence of the Bassini suggestion, that is opening the inguinal canal freely to facilitate removal of the sac and to yield a better opportunity for the repair of the musculo-aponeurotico-fascial layers, was unquestionably a revolutionary step in the right direction. Bassini deserves lasting credit for directing the attention of surgeons to the importance of the repair of the abdominal (internal) ring in contradistinction to the previous emphasis on the subcutaneous (external) ring. My personal suggestion is simply a new technique for the surer and better closing of the abdominal ring, together with the reasons for my step.

All modern herniotomy techniques split the aponeurosis of the external oblique muscle in the direction of its main bundles throughout the length of the inguinal canal. And further, all techniques remove, or otherwise destroy, at least the inguinal portion of the hernial sac. But, beyond this point, all is babel. Thus, for example, we have the Bassini operation, with and without transplantation of the cord (incidentally differences of opinion as to what constitutes transplantation), and the radically variant Ferguson-Andrews technique, together with the innumerable minor variations as regards steps and suture material of individual operators. Enough has been said to show that inguinal herniotomy is still far from a standardized operation and that surgeons, as a class, are as yet not satisfied with their technique and results.

In order to simplify our problem, and to keep in touch with the spirit of the day, let us confine our discussion to the typical hernia of vigorous adult life, that is, the indirect inguinal hernia. For among potential soldiers the direct type, that is actually descending medially (internally) to the deep epigastric artery, is comparatively a negligible factor. Here we have ideal conditions, that is vigorous, otherwise sound men, and hernias of small or average size. And yet, without going into statistics, most of us, I am sure, will admit that the eventual failures of the average surgeon, even in this selected class of cases, are considerable, while the most competent surgeons report many disconcerting and somewhat unexplained recurrences. Many recurrences due to obvious causes, such for example as infections, chronic cough and too early return to heavy physical strain, should, in fairness, be eliminated from the failures. But, after eliminating this group, a variable percentage of failures remain, many of which I, personally, attribute to a faulty technique in the closure of the abdominal inguinal ring.

As true hernias never exist without peritoneal sacs, and, as such open sacs always allow the escape of intestines on the slightest increase in intra-abdominal pressure, nobody doubts the interdependent relationships of hernias and their sacs. But peculiarly in regard to inguinal hernia, at least, the argument has been generally accepted that the open sac caused the hernia to the practical exclusion of the other equally possible alternative that the hernia caused the sac. The pendulum, however, has begun to swing the other way, as even a superficial comparison of the run of modern texts and literature with the older will demonstrate. If this is really another case of the confusion of cause and effect, as many of us now feel, the wideness of the acceptance of the older argument will prove an interesting subject for the psychologist and the medical historian. The gist of the newer argument is that hernia is caused by greater intra-abdominal pressure than the particular wall can withstand; that under such circumstances a hernia forces its way out through the musculo-aponeurotico-fascial layers of the abdominal wall; and that the hernia causes the sac in absolute contradistinction to the older opinion that the sac caused the hernia. As I have recently briefed this argument in some detail elsewhere,[1] I will simply state here that the past year has not caused me to wish to add or substract one iota from that discussion.

The discussion of whether the sac causes the hernia, or, as many of us now believe, the hernia causes the sac, might, at first glance, seem far afield from our subject of operative technique. And yet this question of theory is the foundation on which my step in technique rests. So far as I can find out the universal custom of resecting the sac and closing off the peritoneal cavity before proceeding to the repair of the musculo-

[1] The cause and prevention of hernia. J. Am. M. Ass., lxix, 776-777.

aponeurotico-fascial layers of the abdominal wall rests on the older conception of the sac causing the hernia. My suggestion in technique is simply to insert the mattress sutures for the repair of the abdominal wall, while the peritoneal cavity is still open. With the finger introduced through the abdominal ring, the strength and character of the tissues forming this ring can be accurately determined and the sutures carried through all the layers of the abdominal wall at appropriate points. Careful surgeons are justly afraid of sinking their needles deeply into these layers from the outside inwardly, but with a finger inside the abdominal cavity, no excuse seems to me pardonable for failure to get a good firm grip on all the tissues forming this ring, that is the internal oblique muscle and aponeurosis, the transversus (transversalis) muscle and aponeurosis, and the transversus fascia. On account of fear in regard to this comparatively blind step, many otherwise competent surgeons skimp the stitch until, as a matter of practice, they have grasped little more than the superficial muscular fibers of the internal oblique muscle. And, in view of the danger of intestinal adhesions, or bladder attachment in the neighborhood of the abdominal ring, only a very brave, or perhaps foolhardy man would attempt as deep a grasp on the tissue as he could safely accomplish from within outwardly. As far as the sac is concerned, I always resect at least the inguinal portion of a thickened sac, while the thin ones can be either resected or inverted as per routine techniques. But I lay so much stress on the repair of the abdominal wall, and so little on the sac, that I seriously doubt whether it is necessary to pay any further attention to it, once the abdominal cavity has been opened.

This really completes my suggestion, but here, just for good measure, are a few personal opinions in regard to minor points in technique. A full curved round needle is much to be preferred to any cutting-edge needle or instrument, as it minimizes the danger of injury to the deep epigastric artery and vein. Incidentally, the term "epigastric" is a misnomer,[1] as, according to the rules of anatomical nomenclature, it should be known as the hypogastric artery (of the abdominal wall).

As regards suture materials, I feel that No. 2 twenty-day catgut will hold the tissues in apposition for a sufficient length of time to insure proper union, provided the knot is tied firmly three times and the free ends are left at least one-quarter of an inch long. If the operation is not properly performed, no non-absorbable suture material will improve the result, while the disadvantages of non-absorbable sutures are too well known to call for comment. From a theoretical point of view, I feel that a superficial scarification of the opposed white fibrous tissues would increase the certainty of early and proper union, but have absolutely no basis except theory for this opinion. In order to obtain a clean and bloodless exposure of the required anatomical parts, I make free use of the well known gauze dissection. As aseptic wound healing should be fairly firm at the end of two weeks, I have allowed some of my patients to get up at the end of two weeks and some even at ten days, with, so far as I could determine, no deleterious effect on the six month result. For the usual indirect inguinal hernia I have long felt that the technique, which most nearly reproduced the normal anatomical relations of the spermatic cord, is much to be preferred to the other proposed techniques. On theoretical grounds, at any rate, I object to any technique which brings the spermatic cord straight out through the abdominal wall, and prefer the technique which brings the cord out on its normal valve slant. In other words, I make use of that Bassini technique which brings the musculo-aponeurotico-fascial layers down to the inguinal ligament of Poupart, deep to the spermatic cord. Finally the cut edges of the external oblique are simply sewn together superficially to the cord. And further, I insist that this is the normal relation of the parts, and is a herniotomy without transplantation of the cord.

In regard to practical results, as any individual operator's personal experience in so big a field could be only as a drop of water compared to an ocean, I will simply state that my early results have been excellent throughout. As I, myself, have only used this step during the past year, and, as hernia results should, in fairness, be checked up after the lapse of three to five years, I lay absolutely no stress on this report of personal results. My excuse for publishing the report is based on my opinion that, in the army, this question is an emergency problem of some importance.

CONCLUSIONS

1. All types of hernia are caused by greater intra-abdominal pressure than the particular wall can withstand.

2. The newer point of view, that the hernia causes the sac, in contradistinction to the sac causing the hernia, deserves serious consideration.

[1] Some suggested changes in anatomical nomenclature. Anat. Record, xiii, No. 3, 165-168.

3. Greater operative emphasis should be placed on the repair of the musculo-aponeurotico-fascial layers of the abdominal wall.

4. My suggestion in technique is that the sutures for the repair of the wall should be placed before the peritoneal cavity is closed.

CORRESPONDENCE

ARTIFICIAL SYNOVIAL FLUID

To the Editor: In June, 1911, I published in SURGERY, GYNECOLOGY AND OBSTETRICS, an account of artificial synovial fluid, a subject which always interested my classes at the school. It would seem to require more or less attention now at the hospitals which are caring for soldiers with joint injuries. The fluid consists in an eight ounce mixture of:

	Ounces
Boroglyceride	1
Glycerine	3
Normal saline solution	4

After the breaking up of adhesions and in cases of chronic inflammation of fibrous structures this fluid injected into a joint acts mechanically in two ways.

1. As a hygroscopic fluid of physical consistency somewhat resembling synovial fluid, it furnishes a benign lubricant which remains in place for days or weeks, furnishing an obstacle to re-adhesion of joint surfaces.

2. As a hygroscopic fluid it has a tendency to unload interstitial infiltrates from the fibrous tissues about a joint, when these are congested as a result of chronic inflammation.

ROBERT T. MORRIS, F.A.C.S.
New York.

BOOKS RECEIVED

Books received are acknowledged in this department and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

SURGERY AT A CASUALTY CLEARING STATION. By Cuthbert Wallace, C.M.G., F.R.C.S., and John Fraser, M.C., F.R.C.S. (E.). New York: The Macmillan Company, 1918.

PROTHÈSE ET CHIRURGIE CRANIO-MAXILLO-FACIALE. By J. Lebedinsky and M. Virenque. Preface by M. le Dr. H. Delagenière. Paris: J. B. Baillière and Sons, 1918.

TRANSACTIONS OF THE AMERICAN GYNECOLOGICAL SOCIETY. Vol. xliii, 1918.

WAR SURGERY FROM FIRING LINE TO BASE. By Basil Hughes, D.S.O., M.A., M.B., B.C. (Cantab.), B.Sc. (Lond.), F.R.C.S., Temporary Major R.A.M.C., T.F.; and H. Stanley Banks, M.A., M.B., Ch. B. (Glasg.) Captain, R.A.M.C., T.C. New York: William Wood & Company, 1919.

SURGERY IN WAR. By Alfred J. Hull, F.R.C.S. With preface by Lieut. Gen. T. H. J. C. Goodwin, C.B., C.M.G., D.S.O., Director General Army Medical Service. 2d ed. Philadelphia: P. Blakiston's Son & Co., 1919.

THE DISABLED SOLDIER. By Douglas C. McMurtrie. Introduction by Jeremiah Milbauk. New York: The Macmillan Company, 1919.

BOOK REVIEWS

A CRITIQUE OF NEW BOOKS ON OBSTETRICS AND GYNECOLOGY

By GEORGE GELLHORN, M.D., F.A.C.S., St. Louis

THE war may have reduced the quantity, but happily, it has not affected the quality of gynecologic literature. Witness in proof thereof, the row of books on the reviewer's desk.

Lockyer, of London, heads the list. This author, long known to us by his contributions on gynecologic pathology, has more recently become prominent as a writer of books. Within less than two years he has published, jointly with Eden, a *Textbook of Gynecology for Students;* he has edited, again with Eden, a *System of Gynecology* in three volumes; and now he has written a book of his own. In times of peace and under the most favorable circumstances, this would be testimony to an exceptional assiduity — under the stress of war it is an exceptional achievement. In this latest work,[1] Lockyer presents to us a monograph of imposing size on uterine fibroids. The book is divided into three parts which deal with myoma, adenomyoma, and operations for myoma respectively, and contains a full account of the pathology, clinical features, and treatment of these tumors. Extensive practical experience and museum collections of unusual size and variety enable the author to contribute to any phase of the subject from his own knowledge and to introduce the results of his personal investigations and scientific researches. Yet, the literature of the world is fully considered and we meet, for instance, with repeated references to the work of Kelly and Cullen. Of Continental writers, German and French authorities are frequently quoted. Beautiful color plates and a multitude of half-tones illustrate both the histologic and the gross aspect of the various forms of fibroids and visualize the steps of the operation described.

A work of such magnitude cannot possibly be reviewed adequately within a limited space, but the few selections appended will serve to whet the appetite of the prospective reader. While the causation of fibroids is obscure and the question of their histogenesis must still be held in abeyance, Lockyer believes that ovarian activity is a determining factor in the development of myomata. The term myxoma should be discarded and the mucinoid change had best be regarded as the liquefactive stage of hyaline degeneration. In the controversy as to the etiology of necrotic fibroids, the author leans to the view that hæmolysis and not thrombosis is the predominant change. He denies any interrelation between fibroids and polypoid endometritis and assumes for the latter an infective origin. The coincidence of cancer and myoma in the uterus is of great clinical importance, but pathologically it cannot be said that one growth predisposes to the development of the other. Sarcomatous transformation, on the other hand, is a well established fact though existing statistics do not indicate the frequency of this occurrence. Submucous polypi in particular should be regarded with suspicion and never be removed without a thorough histologic examination. As to the question of the heart in cases of myoma, Lockyer rejects the possibility of specific myoma toxins inimical to the heart and refers the cardiac lesion back to anæmia. The effect of pregnancy on a myomatous tumor is very marked, but induction of labor or abortion should never be performed. Expectancy gives the best chances to mother and child.

This leads us to the subject of the treatment of fibroids, and here we find the same completeness of detail that may be assumed from the foregoing excerpts from the chapters on pathology. Both the operative and the non-surgical therapy are dealt with on a broad basis and with a fairness altogether refreshing. The diagnostic chapters are equally rounded out and contain not a few diagnostic signs which seem to have been permitted to lapse into oblivion. If the reviewer does not continue to quote from his notes, it is due to fear of the editor's blue pencil. Moreover, there is no need of going into further detail, for it must be evident by now that the treatise before us is one which is indispensable to any up-to-date gynecologist.

There is, to the reviewer's mind, yet another aspect from which this book appears momentous. We have fondly believed in the past that Medical Science was in truth international, that it knew no geographic bounds, that it stood serene and sublime above empires and republics, knowing no sovereignty but that of Humanity.

The war has shattered many such illusions and shown that men of science are first of all human beings. Now that the nightmare is ended and reconstruction is upon us, many bridges must be laid across the gaping chasm to unite once more mankind torn asunder; and this book of Lockyer's is just such a bridge for it encompasses all the

[1] Fibroids and Allied Tumors. By Cuthbert Lockyer, M.D., B.S., F.R.C.P., F.R.C.S. London and New York: The Macmillan Company, 1918.

wisdom of the world on a certain subject, and medical men of all tongues and all nations will have to turn to it for reference, again to study together, to work together, to serve together for the sake of Humanity.

A TEXTBOOK is a thing that is associated in one's mind with hard work on the part of the student. A chapter, or two perhaps, to obtain some desired information and then it is laid aside until another need arises. But here we have a book[1] that one does not put down after a chapter or two, but keeps on reading and finds in the end that it has not only been immensely instructive, but entertaining as well. We encounter the Freudian theory on the sex impulse and wonder why other authors have not thought to embody this important chapter in their textbooks. In the section on the relationship of gynecology to the internal secretions, we find the few definitely established facts hulled out of a maze of contradictory and confusing observations, the plausible theories clearly pointed out as a working basis, and the lines of further investigations plainly indicated; and everywhere we see the author's active collaboration on a subject that may yet revolutionize our entire conception of gynecology. There is further an interestingly written discourse on the relations of gynecology to all the other organs and systems of the body which correlates our special field of work to the other branches of medical science and emphasizes the point that gynecology can no longer be regarded as an offshoot of either surgery or of obstetrics. And so this first part of the book is, in reality, a treatise on general gynecology and would be a distinct gain to literature even were the work to end here.

But there are two more parts. In the second part, gynecologic diseases are treated at length. The undergraduate student will find this part particularly attractive. Both the microscopic and macroscopic illustrations, the latter from the author's hand, show a high degree of perfection and serve, in conjunction with the precision of the text, as a true guide into the theory and practice of gynecology.

In the third part which deals exclusively with operative gynecology, text and illustrations vie with one another in a clear and helpful presentation of our surgical procedures.

We have welcomed the first appearance of the work with warm recommendation, and this second edition deserves even higher praise.

A BOOK which appears in its eighth edition, *per se* relieves a reviewer of his responsibility. The eight editions speak too loud and eloquent a language to require more than a simple announcement. But in this case[2] the reviewer cannot refrain from pointing out that the author personifies in himself that happy union of the sister sciences of obstetrics and gynecology, from which alone progress and a perfect understanding of all reciprocal problems can come. Hirst is one of the few authorities who have written textbooks both of obstetrics and gynecology.

In the present volume his long experience as a teacher has helped him to recognize and omit material unessential to the medical student and general practitioner. Thus, while all real advances in obstetrics are embodied in the work, the size of the book is smaller than that of former editions. In the galaxy of American textbooks of obstetrics, this one occupies an honored place.

THE second edition of Shears' *Obstetrics*[3] has preserved the excellent qualities of the first edition. Originality of conception, vividness of description, and proper valuation of practical needs are the dominating features of the work and warrant the prospect of a long and successful career. Unfortunately, certain technical imperfections were likewise preserved which, in the first edition, could be overlooked as due to hasty proofreading. In this second "revised" edition, they should have been eliminated. Such shortcomings, however, should not be permitted to mar the intrinsic value of the book.

CROSSEN'S textbook[4] proves its popularity by a fourth edition. In the absence of the author in France, Dr. Hugo Ehrenfest has attended to the revision. He has succeeded in bringing the book up to date by deft touches, adding valuable facts which have come to light since the last edition, and eliminating doubtful or unessential matter. He has also written a chapter on the relationship of the endocrine glands to the female genitals in which this complicated subject is set forth in systematic and succinct manner. The book will be a staunch friend to students and general practitioners.

THE last book[5] to be reviewed is inferior to its precursors only in size. In its subject matter it takes front rank in the reviewer's opinion and should receive the careful and appreciative attention of teachers on obstetrics. "These talks," says the author "are merely printed chats similar to those often held with students during the hours of waiting while on out-patient cases." The more common complications met with in obstetric practice are set forth in thirteen short chapters, and the conversational style preserved throughout makes the reader forget that he is absorbing a great deal of practical experience and sound judgment. The book is small enough to be slipped into one's pocket and is, in truth, a genuine *vade mecum*, a constant companion in the work of the obstetrician.

[1] GYNECOLOGY. By William Graves, A.B., M.D., F.A.C.S. 2d ed. Philadelphia and London: W. B. Saunders Company, 1918.

[2] A TEXT BOOK OF OBSTETRICS. By Barton Cooke Hirst, A.B., M.D., LL.D., F.A.C.S. 8th ed. Philadelphia and London: W. B. Saunders Company, 1918.

[3] OBSTETRICS, NORMAL AND OPERATIVE. By George Peaslee Shears, B.S., M.D., and E. E. Shears, M.D. 2d ed. revised. Philadelphia and London: J. B. Lippincott Company, 1917.

[4] DISEASES OF WOMEN. By Harry Sturgeon Crossen, M.D., F.A.C.S. 4th ed. St. Louis: C. V. Mosby Company, 1917.

[5] TALKS ON OBSTETRICS. By Rae Thornton La Vake, M.D. St. Louis: C. V. Mosby Company, 1917.

AMERICAN COLLEGE OF SURGEONS

CASE RECORDS AGAIN

HOSPITAL standardization, according to the American College of Surgeons, is a poor phrase to describe a good purpose. The purpose is to improve the service which sick people receive in hospitals. In its program the College has centered its aim. In effect the College says, "There are many, many things to be done by the medical profession and by hospitals in the way of better care for sick people. But let us not try to do all of them at once. Let us, first, turn our attention to the most imperative needs of a good hospital; to the needs about which there is no debate and without which no hospital may claim the approval of its community. These needs are, first, case records; second, clinical laboratories; and third, staff organization.

The College has recently published two bulletins on the subject of case records, some account of which was given in the last issue of the JOURNAL. The bulletins met with heartiest response from the medical profession, from the hospital administrators, and from the public. An occasional misconception, however, arises with regard to the records. How "complete" must a record be in order to be adequate? is a usual question. Again, how much laboratory work must be done in each case?

The answers to these questions obviously lie in sound medical training. A case record is not an ornament and quite as definitely a case record does not normally include laboratory work unless such work was actually needed or deemed advisable in the diagnosis or treatment of the particular case. For instance, it would not be expected that a Widal should be taken in a fracture case, nor would a Wassermann be expected in an obvious appendicitis, but it would be regarded as highly neglectful and an evidence of slipshod work if an obscure bone disease were permitted to proceed to operation without a Wassermann having been made.

In other words, the clinical record ought to show everything that was done in each case; and what was done in the case ought to include every reasonable effort to ascertain exactly what was the matter with the patient. The doing and recording of unnecessary laboratory work in a case are not only a cause of unnecessary expense, but are also evidence of faulty medical or surgical practice.

But the chief difficulty in the way of adequate records today is not the laboratory phase just stated. It lies rather in the thorough study of the case, first, through a personal history and, second, through a physical examination. The confusion of these two parts of a case record is so usual that some emphasis is here given the subject.

PERSONAL HISTORY

The personal history is, in effect, the patient's story of himself in relation to his complaint. It is not a diagnosis; it need not be verbose or elaborate. But the personal history should include every point likely to be of interest in leading up to the illness for which the patient came to the hospital. It included his family history; any family traits that might have a bearing on his own condition as, for instance, nervous manifestations. Incidents or previous illnesses of the patient may have a marked bearing on the case under discussion. An early inflammatory rheumatism, for instance, contracted during childhood might have a marked effect in accounting for a heart condition. A ptomaine of years ago might easily have something to do with a disturbed stomach function at the present time.

The patient should be catechised carefully as to the beginnings of his present illness; the symptoms, their extent and durations.

The parts of the body should then be discussed with the patient from his standpoint; he should be required to think about himself with the mind focused on one question at a time. It is not sufficient that the patient be asked whether or not he has had any previous illnesses. Has the patient ever had headache? If so, what was its character? Have his ears ever troubled him? Or his, eyes or nose, or mouth, or throat? Oftentimes a patient will entirely forget something that may be most important on which his memory is checked by reference to that particular thing.

It is not sufficient that the patient be asked whether he has ever had heart disease, or anything the matter with his heart; he must be quizzed about shortness of breath, palpitation, vertigo, swelling of the feet, puffiness of the eyelids. Then the physician can determine whether these incidents point to previous heart trouble.

The same detailed examination must go through every part of the body; the chest, the abdomen, the extremities, and the genito-urinary system.

Too often the personal history sheets are merely marked "negative," and give evidence, not that the examiner has made inquiry in these different directions, but that he has assumed that they had no bearing on the case.

THE PHYSICAL EXAMINATION

The physical examination is what the doctor finds on examination. It is not the patient's story. It is a statement of actual objective facts and this examination taken in conjunction with the personal history make up the basis of the diagnosis.

The clinician is now assumed to know what the patient has had to say about himself and the time is at hand when the patient's story is checked up by an actual examination. The obscurity or simplicity of a case will determine in the main, the extent of the physical examination. The point at issue is the diagnosis and if this can be made by going direct to some indicated part of the body or to some group of symptoms and can be so plainly determined as to leave practically no ground open for debate, then it would seem that this direct course is permissible. If the diagnosis is obscure every point should be thoroughly covered and studied. It is important to remember that whatever the illness of the patient, that illness bears a relation to the entire body and all significant fact in this connection should be recorded.

In the two bulletins (Vol. IV, Nos. 1 and 2) full detail is given as to the distinction between a personal history and a physical examination.

Some indication of the need that the medical profession give keen attention to physical examinations is clear in the following figures. In a group of 603 hospitals in the United States and Canada last year, 27.4 per cent of the patients received careful physical examinations. In this group some 1,546,000 were admitted to the care of the hospitals and later discharged without physical examinations.

CASE RECORDS FOR PRIVATE PATIENTS

It is considered settled that careful, accurate, and comprehensive case records should be kept on all ward patients in the hospital. There seems to be no argument about this. Hundreds of hospitals keep these records well. But many physicians and surgeons hesitate about keeping detailed records on their private patients, and this feeling has been responsible for much carelessness in record keeping. Under such circumstances the administration of the hospital naturally concludes that if the bars are down in one place they might just as well be down in other places.

Much serious thought is due on this subject of records for private patients. The problem is difficult. Many doctors feel that their relations with their private patients are confidential and that these cases are not to be talked about by outsiders. The result is that some of these doctors keep rather accurate records in their own offices and not in the hospitals, although the patients are cared for in hospitals. Other doctors keep no records at all of private patients. A woman, for example, has a miscarriage, or has several mishaps of the sort. Obviously the case is not one for outsiders to know about. A Wassermann has been made and the result is positive, which may account for the abortion. There may be a gonorrhœal history connected with the patient, or something in the story

that goes back to a syphilitic history. Very rightly these are things which are not to be talked about.

And, yet, should not a full record be kept? Does not the patient, himself or herself, frequently suffer because of the want of an adequate record? Suppose the doctor treats a private case and makes no record of it; and suppose that later he dies, or that the family moves away, or that for some other reason a new doctor is called into the case. Is not the patient entitled to have the experience gained by the first doctor available for use under the new conditions? The answer is undoubtedly yes. The data should be available to the patient, private or clinical.

What is to be done? Nearly all objections to the keeping of records for all patients disappear if the hospital records themselves are private and inviolable and not subject to review by any one who has not a definite right to know what the records contain. The answer is, of course, that hospital records are confidential data and should not be seen or known by any one excepting in the interest of the patient and on the patient's order or on the order of the doctor authorized by the patient. The protection of the records is a responsibility which the hospital owes to each doctor who practices in it.